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AN ESSAY
ON
MINERALOGICAL CLASSIFICATION
AND
NOMENCLATURE;
WITH
TABLES
OF
THE ORDERS AND SPECIES
OF
MINERALS.

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The Author of the following pages is very desirous of drawing the notice of men of science to that view of Mineralogy which the subjoined Tables are intended to illustrate. Though fully convinced that by this road Mineralogists may best hope to be led to substantial and general truths, he offers all the details of the System with very great diffidence. To discover and define the nature and connexions of the Species of minerals, is an object which may still long employ, and not unworthily, the continued and careful labours of Mineralogists and Chemists.

Trinity College,
May 24, 1828.

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ON

MINERALOGICAL CLASSIFICATION

AND

NOMENCLATURE.

SECT. I.

INTRODUCTION.

It is not the design of this essay to propose a new system of mineralogical classification. The more limited object of the following pages is to compare the groups of minerals which are associated by outward properties, with a view to discover what are the resemblances and differences of their chemical constitution. This seems to be the method by which we may best hope to approach the most natural and true arrangement of minerals, and to obtain some insight into the nature of the laws by which the chemical composition determines the external character.

It is clear that such a purpose as this is inconsistent with any disposition to reject either the chemical or the physical properties of minerals. It necessarily implies that both are to be attended to. The very scheme however of instituting such a comparison, requires that, in the outset at least, these two branches of our knowledge should be kept distinct. How they are to be reconciled and combined, the comparison itself may be expected to shew.

For the purpose of making this comparison without confusion, it is necessary previously to explain and regulate a few points with regard to the rules, nomenclature, and notation of the sciences with which we are concerned; and these points shall be treated as briefly as possible.

It appears to be capable of being most satisfactorily shewn, that the rules hitherto proposed for the chemical arrangement of minerals cannot be consistently applied. That strictly followed, they would make it impossible to determine of what species any single specimen was till that specimen had been analysed; and that many very distinctly characterized minerals would be no species at all. See Sect. II.

To exhibit clearly the chemical constitution of bodies, formulæ resembling algebraical formulæ seem to be convenient and almost necessary. The notation which has been for this end proposed and partly adopted, has the fault of violating the plainest analogies of the symbols which it employs, and hence forfeiting the main advantage of such a notation, which consists in its leading us at once to the conclusions which are numerically deducible from the data. To remedy this defect must be considered as important to Chemistry itself, as well as to such a use of it as is here made: and this is executed in Sect. III.

In order that we may make any assertions concerning minerals, we must have names for them; and considering the great uncertainty, multiplicity, and irregularity of the mineralogical terms most in use, any system which should make them at the same time simple, regular and easily intelligible would be valuable. It is conceived that the names proposed in the following Tables would, if adopted, offer these advantages. See Sect. IV. It must undoubtedly be granted that in such a matter any change is an evil: but the only way to prevent endless mutability, seems to be to modify the names at present, in such a manner as to reduce them to rules which may fix them for the future. It must also be confessed that names, though easily intelligible, will, if in a new form, sound repulsive and uncouth. But this strangeness a very short usage will certainly overcome, when, as is the case here, the new names have a close analogy with familiar old ones. If we speak of Cobalt Bloom, why should we be revolted at Copper Bloom or Pharmacon Bloom? If we have Copper Green, why may we not also have Dioptase Green or Lens Blue? If however these new names are too repugnant to our habits to be tolerated, it would be easy to substitute others; for instance, PHYLLITE for *Bloom,* and MALACHITE for *Green.* The principle of the nomenclature would remain the same as it is proposed to make it, and the terms would be almost equally convenient. It is to be observed also, that the names just quoted are almost the only cases in which so much of novelty has been introduced*.

SECT. II.

ON THE CONNEXION OF MINERALOGICAL AND CHEMICAL CLASSIFICATION.

The classification of the mineral kingdom has not in this country attracted much attention. Various causes might be assigned for this neglect: but that it is not considered an unimportant object in other countries, is rendered obvious by the attempts which have been made by some of the most distinguished mineralogists and chemists in Europe to execute the task. Mohs and Breithaupt have published treatises in which physical or external mineralogical characters determine the classes of minerals. Berzelius, Gmelin, Beudant and Leonhard, have given arrangements of the same substances according to their chemical relations.

Now whatever may be thought of the respective merits of these two modes of classification, this will probably be allowed;—that either of them would receive a remarkable confirmation if it conducted us to the other:—That if the classes selected in consequence of their external properties, were found to have each some peculiarity or common analogy of chemical constitution;—or if the divisions made by the chemists were found to consist of minerals with striking external resemblances;—we should acquire a sort of criterion that we were approaching to a system which was both chemically and mineralogically true; and its claims to be adopted would probably be readily acknowledged.

This seems to be so promising a view of the subject, that it may be no unprofitable task to compare the results of the two methods of arrangement with this purpose. And it may be considered fortunate, that we have at the present moment the means of doing this in a very satisfactory manner. For the

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* I might add with regard to Order VI, that when we have spoken of Mesolite, Natrolite, Amphibolite, &c., it seems no great innovation to call them collectively *Lites*. But if this is felt to be inconvenient, the Order might be termed Litholites, or any similar name, and the rule for the species might remain as it is given in speaking of that Order.

two sects of classifiers, the mineralogists and the chemists, have each professed to apply their principle pure and unmixed, without any respect to the information derived from the others;—the former party maintaining the necessity of excluding, in this department of the science, all reference to the analysis of a mineral; and the other following as their guide its analysis only. Hence they are independent witnesses, and any coincidence in their results may afford us substantial materials for further inference.

When we begin to speculate concerning the connexion of mineralogical characters with chemical composition, perhaps the first impulse of the mind is to *guess* at what we may suppose to be the rule of this connexion.

It seems for instance probable, that the nature and distinguishing character of a body should be decided by its ingredients. It might therefore be easily supposed that its *greatest* ingredient, or, taking into account the doctrines of the atomic theory, perhaps the ingredient of which there should be the greatest number of particles, should determine the properties of a mineral, and consequently its place in the system. But though this hypothesis might be assumed and tried, (as it has been by most of the chemical classifiers) it is manifest that it is only one among many supposable hypotheses, and may be a false one. We can imagine other chemical arrangements as easily as this: we can suppose that it may be the *kind* of the elements, and the *mode* in which they enter into the composition of the substance, rather than any one element, which determines the *kind* and class of the mineral. For instance, instead of having a class associated by the circumstance of all its members containing *iron*, it may be that all the *oxides* of *metals*, whatever be the metal, shall require to be classed together; or it may be that all the *bi-oxides* shall form one class, all the *tri-oxides* another, and so on.

This is not only conceivable, but so far really the case, that several of the more recent chemical classifiers have, in arranging the mineral species into divisions, been guided by some such chemical analogy, as well as by the leading ingredients. Thus Leonhard's groups are "*hydrous metallic acids and their combinations;*" "*anhydrous oxygenated mineral acids and their combinations;*" "*anhydrous metallic oxides;*" "*metals;*" "and other similar classes. Some of Gmelin's divisions are "*simple hydrosulphates;*" "*duple hydrosulphates;*" "*simple silicates;*"

"*duple silicates;*" "*triple silicates.*" Beudant's families and genera are however governed in the greater as well as the smaller divisions by one of the ingredients. And the first system of Berzelius was in this way theoretically the most complete, because, arranging the elements in a certain order according to a single and uniform principle, and then making the place of a mineral in the system depend on that ingredient which occurred first in this order, no part of the system thus formed could be inconsistent or uncertain.

Such systems as this therefore, though exceedingly artificial and inconvenient, would be consistent with themselves and tenable, if the same mineralogical species always consisted of the same ingredients.

But a discovery of modern times, that of the property which has been called *isomorphism*, has shewn this method to be in many cases completely inapplicable: so that it is not a matter of convenience only, but of absolute necessity to reject it. And accordingly Berzelius has acknowledged the need of a complete reformation of his first method, though he has tried to shew that such a reformation is possible, and that the system is not to be altogether abandoned.

According to the discovery which has been mentioned, it appears that the ingredients of a mineral cannot be used to determine its class, because in many instances, the ingredients may be very different while the species remains mineralogically the same. The ingredient which discharges a certain function in the composition of the mineral, may be either one or another of two or more elements; and in this respect these elements may replace one another, or enter alternatively. Thus, *garnet* is composed of silicate of alumina and bisilicate of lime, combined in certain proportions. But it appears that without the mineral ceasing to be garnet, the alumina may be replaced by trioxide of iron, and the lime by bioxide of iron or of manganese. And these substitutions may take place not only for the whole, but also for a part of each of these ingredients; so that we may have garnets where a certain proportion of the atoms is made up of alumina and trioxide of iron together, with no further restriction as to the number of each.

Now it is manifest that this circumstance renders it impossible to classify minerals according to their chemical composition. For if we make the varieties of garnet arising from these different ingredients to be different species, we make the species independent of the mineralogical characters, and practically useless; since we shall require an analysis to enable us to name any one specimen. And even theoretically, we should be unable to apply such a rule of arrangement, since the number of species belonging to each such mineral would be infinite. For the elements which replace each other may be combined in any proportion: 99 of alumina and 1 of oxide of iron; 98 of the first and 2 of the second; 3 of the first and 97 of the second, and so on. Or if these different combinations were not considered as species, but as *mixtures* of species; the result would be that almost all minerals which occur in nature, would belong to *none* of the pure species, but would appear in the appendix to each group. And this is in fact what happens according to Beudant's analyses.

Thus he takes a number of actual garnets, and from their analysis he finds that they must be conceived to be thus composed of parts of various species; (*Beudant, Tr. El. de Min.* p. 252.)

Grenat Melanite	24.85
Grenat de Chaux	56.51
Grenat d'Alumine et Magnesie	4.00
Grenat de Manganese et Magnesie	7.00
Trioxide de Manganese melangé	2.38
Magnesie melangé	3.47
	98.19

It is sufficiently apparent that a mode of determining species which requires to be applied in this manner, cannot answer the end of practically classifying minerals.

What is the true nature of mineralogical species, and what its relation to their chemical constitution, we may hope to learn by comparing, as has been said, the species and divisions of minerals independently established with the chemical analysis of each. For the purpose of instituting this comparison, it will be necessary that we should have a mode, as precise and compendious as possible, of expressing the chemical constitution of compound substances. And as a notation by letters seems to offer great advantages in this respect, and indeed to be indispensable, we shall now proceed to explain that notation which we shall adopt.

SECT. III.

ON CHEMICAL NOTATION.

To form a chemical notation, we must first have modes of designating all elementary bodies: and this is done most simply by using for the greater part of them some of their initial letters. Berzelius, who has proposed such a notation, has followed this rule; and we shall adopt his letters, (a respect which seems due to the first inventor of such a method,) except when the system may be made more simple and systematical by introducing slight alterations.

We shall also arrange simple substances nearly according to the order in which they are placed by Thenard in his work on Chemistry. He divides them as follows: metals of the *first section,* or metals of earths; metals of the *second section,* or metals of alkalis; metals of the *third section,* or those which decompose water at a red heat, &c.; metals of the *fourth section,* or those which do not decompose water, but which absorb oxygen at a more or less elevated temperature, and are irreducible by heat alone; metals of the *fifth section,* which absorb oxygen, but are reducible by heat alone; metals of the *sixth section* which do not absorb oxygen, and are easily reducible by heat. Finally, we shall place the *acids* or their *bases,* leaving out of view, as not at all affecting our design, any differences of opinion among chemists as to their nature and theory.

These simple substances are in most cases combined with oxygen, and as this element is so universal as to require to be designated in the most simple manner, we shall indicate it by placing one or more *dots* over the symbol which represents the simple substance. The number of dots will represent the number of atoms of oxygen which, according to the atomic theory, are combined with one atom of the base. Thus Fe being used to represent *iron,* $\ddot{Fe}$ will represent the *bioxide,* $\dddot{Fe}$ the *trioxide* of that metal, and similarly in all other cases.

The arrangement of the simple elements above spoken of, supposes that the earths as well as the alkalis, have a metallic base. If however this doctrine be not certain, its uncertainty will not much affect our subject. $\dddot{A}$ and $\dddot{S}$ represent the earths *Alumina* and *Silica* on the supposition that each consists of one atom of a metallic base, and three of oxygen: but the truth of this supposition concerns the chemical theorist only.

I have endeavoured to simplify the notation of Berzelius, by using in most cases single letters for the metals of the first and second sections: A instead of Al for *Aluminum*; S instead of Si for *Silicium:* $\ddot{C}$ instead of Ca (*Lime;*) $\ddot{M}$ for Ma (*Magnesia;*) &c. Also K and N for *Potassa* and *Soda,* (*Kali* and *Natron*) instead of Ka and Na. I have preferred these to Beudant's symbols, Po and So, both as belonging to Berzelius's original proposal, and as less likely to be confounded with the symbols of the other elements. For the same reasons I have retained Sb for *Antimony* (*Stibium*) and W for *Tungsten* (*Wolfram*). In cases such as *Stibium* and *Strontian,* I have not used the two initial letters St for either, but have taken one of the more distinctive letters of the word for each (Sb and Sr). So *Silver* (*Argentum*) and *Arsenic* (Ag and As) *Platinum, Palladium* and *Lead* (*Plumbum*) (Pt, Pd and Pb).

In several instances the initials of the Latin names of metals have been taken, both for the above reasons, and also because it seems inconvenient to give our symbols an origin which must confine their use to one European nation. And we may add as another reason, that in forming derivatives from such names, we usually proceed as if the Latin word were the root. Thus the symbols have been adopted, formed from *Calx, Aurum, Argentum, Hydrargyrum, Cuprum, Ferrum, Plumbum, Stannum, Stibium.*

The *Acids* are distinguished by having their radicals represented by small letters: and those acids of which it is not now generally allowed that oxygen is the acidifying principle, are nevertheless here indicated with dots as if it were. By this means the analogies of composition seem to be made more obvious for the present; and when the chemical laws of this part of mineralogy have been clearly made out, the notation can easily be modified so as to correspond with our knowledge. Thus Fluor Spar is $\ddot{C}+\ddot{f}$, while according to Beudant it would be $Ca+Ph$; Ph (*Phtore*) being the radical of fluoric acid. So Rock Salt is $\ddot{N}+3\ddot{m}$, which is with him $Po+4ch$ (ch being *Chlorine.*)

The elements or atoms of bodies being thus indicated, their combinations are represented by writing them with the algebraical sign + between them. Thus *Carbonate of Lime* (Calc Spar) is $\ddot{C}+2\ddot{c}$; which implies that we have in the substance 2 atoms of Carbonic Acid combined with 1 of Lime.

But it often happens that we have bodies which are composed of atoms already themselves compounded. For instance, in the composition of *Garnet*, we have an ingredient $\dddot{A} + \dddot{S}$, and another ingredient $3\ddot{C}+2\dddot{S}$; and the garnet contains 2 atoms of the first ingredient combined with 1 of the second. And it is therefore represented thus $2(\dddot{A}+\dddot{S})+(3\ddot{C}+2\dddot{S})$. And the same rule will apply in all other similar cases.

It is clear that the garnet just mentioned might be thus represented, $2\dddot{A}+3\ddot{C}+4\dddot{S}$: and this formula does in fact indicate the immediate result of analysis; the forming of its elements into two parts being a theoretical process depending upon the doctrine of definite proportions.

In cases of isomorphism, the isomorphous ingredients are thus arranged, under each other:

$$\left.\begin{array}{llll}\text{Garnet} = & 2(\dddot{A}+\dddot{S}) & + & 3\ddot{C}+2\dddot{S} \\ & \;\;\dddot{Fe} & & \;\;\ddot{Mn} \\ & & & \;\;\ddot{Fe}\end{array}\right\}.$$

The atom of water is indicated by q.

As the chemical formulæ made use of in the succeeding pages, will be given entirely on the authority of chemical authors, it is not necessary to explain the mode of deducing them from the analysis. It may however be observed, that according to the doctrine of definite proportions, the number of *atoms of oxygen in two ingredients of a compound*, must be in some simple ratio as 1; 2; 1: 3; &c. And these numbers of atoms are found, by multiplying the dots over each letter by the number which multiplies the letter itself. Thus, $3\ddot{C}$ has 6 atoms of oxygen, $4\dddot{S}$ has 12, &c.; hence in $3\ddot{C} + 2\dddot{S}$, the oxygen of the lime and that of the silica are equal. In $3\ddot{Fe} + 4\dddot{S}$, the silica has twice as many atoms of oxygen as the iron has. In $\ddot{Pb}+2\dddot{W}$ (Tungst~~en~~ /ic ~~Cal~~ Lead Spar) the tungstic acid has three times as much oxygen as the lead: and so on. It might appear from some of the formulæ for mineral substances, as if the ratios of the atoms were not so simple as the atomic theory usually supposes; but in these cases a more complete chemical examination of the subject will probably remove the difficulty.

This mode of designating the combinations of chemical elements, is different from that of Berzelius and of Beudant, but the alteration seems to be absolutely necessary. According to their method, the first combination of elements, into binary compounds, is indicated by writing their symbols together, without any connecting sign, as if they were algebraically multiplied; and the number of atoms of each element is denoted by figures written as indices of powers generally are. Thus $C + 2\ddot{c}$, they would represent by $\ddot{C}\ddot{c}^2$ and $3\ddot{C} + 2\dddot{S}$ by $\ddot{C}^3 \ \dddot{S}^2$. Then the combination of such compound ingredients is represented by writing them with the sign + between them, and with their proper multipliers. Thus the composition of garnet, which we have denoted by $2(\dddot{A} + \dddot{S}) + (3\ddot{C} + 2\dddot{S})$, they would write $2\dddot{A}\,\dddot{S} + \ddot{C}^3\dddot{S}^2$. Now this notation is in the highest degree inconvenient, besides violating all symmetry and analogy. For when the substance is indicated by $2\dddot{A}\,\dddot{S} + \ddot{C}^3\dddot{S}^2$, there is no longer any obvious identity with $2\dddot{A} + 3\ddot{C} + 4\dddot{S}$ which is, as was before said, the real result of the analysis; while, according to our notation, this identity is contained in the nature of the algebraical symbols. Both steps of the composition (into binary compounds, and into combinations of these) are alike addition, and cannot be represented in any other light without forfeiting all the advantages of a notation, and reducing it to an arbitrary and often imperfect mode of registering results; instead of making it, as it may be made, a convenient method of exhibiting the inferences to which an analysis may lead. I shall therefore, though not without reluctance in introducing such a deviation from great authority, entirely abandon this system of notation.

The composition of all minerals which have been correctly and scientifically analysed may, by means of the symbols now explained, be exactly and intelligibly represented. The principal authorities which I shall refer to for such analyses, will be Berzelius and Beudant; and I shall take their results precisely as they have given them, without attempting to make them more simple or consistent. For that which is mineralogical, we may take the authority of the mineralogists; and for that which is chemical the authority of the chemists; without presuming to question or alter the data thus offered. Our present business is to compare their results, and to shew in some measure what are the leading principles and distinctions suggested by such a comparison.

The nature of the chemical relations by which one class of minerals differs from another, will be best understood by referring to the tables of them which follow. But it may be observed, that if the chemical analogies of each class were completely and certainly known, we might probably express them by means of an algebraical formula, in which some of the symbols might have any of several elementary letters substituted for them. Some of the groups and orders, as Garnet, Amphibole, Zeolite, &c. seem to lead to such expressions. But it seems probable that our knowledge of the analogies among minerals and of their laws and limits, is at present too imperfect to supply us immediately with most of these formulæ. When minerals have been sufficiently examined and studied by accurate and intelligent chemists *in this point of view*, we may hope to see the subject assume a much greater simplicity and order than we can at present detect. And it does not appear too much to say, that by this means no small light will be reflected back upon Chemistry, through the relations thus to be discovered among those ingredients which occupy similar places in our formulæ.

We find here for instance, that some oxides of metals ($\ddot{Fe}$, $\ddot{Mn}$) seem to belong to a certain class of earths, $\ddot{C}$, $\ddot{M}$, &c., while other metallic oxides ($\dddot{Fe}$) arrange themselves with a set of earths of a different function ($\dddot{A}$, &c.) In the same way, we find phosphoric and arsenic acid occurring analogously; we find in some cases selenium, in some arsenic, in some tellurium, imitating sulphur in the properties they impress upon metals by their combination.

Several other probable connexions might be pointed out, but for any thing like a systematic induction of this kind, the subject does not appear yet to be ripe. It may however be worth while to notice the general order in which the different elements occur, as we travel through a system which was constructed without reference to them. In the 1st and 2nd of our 13 Orders (Salts and Spars) we have alkalis and earths combined with acids. The combination of alkalis and acids is not found after the 1st order. The 2nd order contains in a great measure the carbonic and sulphuric acids, which afterwards scarcely occur. Muriatic acid appears in the third order (Horn-metals). Phosphoric and arsenic mainly characterize the 4th and 5th, (Blooms and Greens) and after these the acids no longer occur as principal constituents. In the next order (Lites or Lithites) silica comes in, and takes, according to the views of Berzelius, the office of an acid. The following 7th order (Gems) has its most simple and characteristic members consisting of pure earths, that is, of supposed oxides of metals. The next order is formed by the oxides of known metals. In the following order oxygen disappears, to reappear no more, and we have, as the center of the system, simple substances, viz. Metals. Proceeding from this on the other side, we find the metals combined with a new substance, sulphur, and substances which resemble it in the effects of their combination. This in various ways, forms the 10th, 11th and 12th orders (Pyrites, Glance, and Blende). Finally, in the 13th order the metals are no longer found, and we have Sulphur by itself as the characteristic member of the family.

This view is to be considered as at present conjectural and approximative only; but it is at least a result, which as far as it can be established, is an evidence of the arrangement here given being well founded, since no such order was contemplated in framing the system.

SECT. IV.

ON MINERALOGICAL NOMENCLATURE.

For the purpose of exhibiting such a comparison as has been proposed of the arrangement of minerals, according to physical characters and to chemical constitution, it is necessary that we should refer to some unchemical classification; and we shall with this view select the classification proposed in the Treatise on Mineralogy of Professor Mohs. This system seems to possess many claims to our preference; but we may for the present suppose this selection to be made merely as an experiment, and from the necessity of beginning with some one case.

It is also requisite to adopt some nomenclature for minerals; and this choice is not without its difficulties, arising from other causes, as well as those belonging to the formation of a system. For the number, the anomaly, the uncertain application of mineralogical names, and their perpetually increasing multiplicity, are such as to be a formidable difficulty in the way of a student, whatever be the method which he follows. For these inconveniencies the only remedy appears to be that some permanent nomenclature should be adopted, and that superfluous and arbitrary names should be rejected.

Now it would seem that such a reform as this, is not to be looked for from any thing except a consistent *system*. For it does not appear how our nomenclature can be limited and purified, in any way which shall obtain general acceptation, otherwise than by assigning sufficient reasons for the rejection of those names which are excluded; and such reasons, if dependent upon any common principles and properties, would tend to form a system.

At any rate it must be allowed, that if our system, besides being valuable in other respects, should offer rules, simple and easily carried into practice, for fixing the names of minerals, this would be a desirable object gained. The systems of classification according to external characters which have been published, have contained also the proposal of a systematic nomenclature for the species: but we may perhaps venture to say that the names which have thus been proposed are not likely to be adopted. No nomenclature indeed can expect to obtain any extensive prevalence and authority if it do not incorporate into itself, for the greater part of the species, names now usually current; or if it require the reader to learn a considerable number of new and newly applied words. Now these objections unfortunately do apply to the names imposed by Mohs and Breithaupt. In the system of the former, almost every mineral species has a new name, which is not intelligible without a knowledge of the system itself: such names, of course, cannot readily find a place in the memory of an uninstructed observer. If they could do this, they might thus prepare the way for the knowledge of the system itself, and be auxiliary to the easy and permanent employment of it. The rejection of old names, and the fabrication of new, are, in both the systems just mentioned, carried to such an extent, that it seems impossible the new nomenclature should ever be habitually used *instead of* the old one. It appears unlikely, that we should ever abandon the easy and familiar appellations of Brown Spar, Celestine, Harmotome, for Brachytypous Parachrose-Baryte, Prismatoidal Hal-Baryte, Paratomous Kouphone-Spar; and it does not appear that much would be gained by our having a systematic and scientific nomenclature of this structure, *in addition to* all the variety of mineralogical names which we at present possess. If therefore any thing can be executed for the benefit of mineralogical nomenclature, it must be attempted in some other way.

The sciences which have been most advantageously assisted by the adoption of an appropriate nomenclature, are *Botany* and *Chemistry*. The artifices of the language belonging to the latter of these sciences, can manifestly be employed only to indicate similar relations and dependencies to those of Chemistry itself. So far as these are to be indicated for minerals, this language, not being sufficiently complete, is superseded by the notation which has already been explained: and it is obvious that for various reasons any thing like a chemical nomenclature of all minerals, even if possible, could not be recommended for common use.

But the language of Botany is well worthy our attention, as an instance of the possibility of overcoming great difficulties of this kind with the most complete success. This language has afforded the means of naming a very extraordinary number of species (it is said above 50,000 of phanerogamous plants alone) without any labour, ambiguity, or complexity. Not only have simple and easily retained names been found for this great number of objects, but Botanists have restricted themselves, in performing this task, to rules of taste and philological elegance, rejecting all that might be barbarous, anomalous, or superfluous. Now, if we look to the causes of this very happy character of botanical language, we shall find it to depend mainly upon the circumstance of its designating each plant by means of a substantive and an adjunct word, marking respectively the genus and the species. To this reason no doubt we must add also others: the fortunate period at which Linnæus, the inventor of this method, published it; his great knowledge and authority in his science, which procured it a speedy victory over the more inconvenient names previously current; his remarkable love of elegance and symmetry in these the externals of his science; and his having included in his system all the best established of the usual names, which has already been mentioned as requisite to the easy reception of such a system. From these causes combined, it has resulted that Botany possesses a nomenclature which has often been justly referred to, as one of the best conceivable specimens of that which may be effected for science, by a well devised and well diffused system of language.

To attempt however in Mineralogy too close an imitation of the botanical mode of nomenclature, would undoubtedly produce no good effect. There are leading differences between the sciences, which make it improper to borrow from the one science any thing more than some general suggestions as to the mode of proceeding in the other. Minerals have not so many details of obvious resemblance and difference as plants have; have not been usually described in Latin; do not seem very clearly to separate themselves into genera; at least not clearly enough to make this the foundation of our names. But notwithstanding these differences, there does seem to be a possibility of establishing a nomenclature burthened with but very few disadvantages, and offering some of the advantages which, as we have seen, may be conceived to be attainable. There are certain divisions of minerals, which it would seem from analogy should rather be called *orders* than *genera;* and which present differences of outward appearance so marked, that they have in many cases influenced the names which have been familiarly given, and might be easily made to regulate them in other cases. Thus we have a number of substances called Spars, respectively, as *Calc Spar*, *Bitter Spar*, *Brown Spar*, *Heavy Spar*, *Fluor Spar*, which approach each other in many of their properties. We have another set of minerals which are called Pyrites, as *Iron Pyrites*, *Copper Pyrites*, *Tin Pyrites*, *&c.* with a similar resemblance. And it does not appear a hopeless attempt to distinguish minerals in such a manner, that names of this form should be found applicable to each of them.

For this purpose minerals are, in the following tables, divided into *Orders* (or divisions corresponding to distinctions of the above kind) as *Spar*, *Pyrites*, &c. which, as they are given in this sketch, nearly coincide with the Orders of Mohs: and it is proposed that, in general, the complete name of a mineral should contain the name of the order to which it belongs: this word and another to distinguish the species, are to form the name of the mineral. This is the only systematic contrivance which I have to recommend; and it appears so easily to fall in with the usual names, and so completely to answer the purposes of a nomenclature, that I cannot but believe it to be generally for the interest of mineralogy that it should be adopted. And that I may not be supposed to wish to introduce any thing from a mere caprice or love of change, I will mention some of the restrictions and considerations by which I have bound myself in the selection of names for species.

1. In the majority of instances I have altered the usual name either not at all, or so slightly, that to a mineralogical reader *no explanation would be necessary.*

2. I have introduced *no new word* whatever*: and have always made use of such names as were in *very common use*, where such were to be found.

3. Where it was necessary for the sake of analogy to modify an usual word, I have made the *alteration as slight* as could answer the purpose.

4. I have framed the name of every species so that it should contain some considerable portion, or *trace, of an usual name* of the species; if possible of *the most* usual.

5. In fixing the *names of* ORDERS, I have not adopted any name which had not *previously* been *usually applied* to *some* at least of the *species* of the order.

6. I have preferred *simple* names to complex ones: *English* words to foreign ones; *short* to long ones: and I have followed the same maxims in the composition of words.

7. Where other things permitted, I have selected such names as marked the *analogies* of the substancies: e. g. Fluor Spar and Phosphor Spar.

8. I have in the introduction to each order given reasons for any of the changes in which the reason did not seem to be obvious of itself.

If, adhering to these rules, and guiding myself by a similar spirit in minuter matters, I have succeeded in producing a mineralogical nomenclature, which contains an accurate reference to a systematic arrangement, while the separate names are simple and idiomatic, I should hope that mineralogists may think it worth their while to accommodate their phraseology to this nomenclature. The same maxims, modified according to the nature of the case, might then govern their selection of such names as they may hereafter have to add to the science.

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* One or two words, such as *Lite, Stilpnous,* &c. which already existed as parts of known words, can hardly be considered as exceptions. The reasons for their adoption are given elsewhere.

I have in several cases altered the terminations of words.

The Order *Gem*, in the names belonging to which that of the order does not appear; the Order *Lite* which is indicated by the last syllable ending in *lite* or *ite;* the Order *Metal,* where the adjective *Native* is prefixed instead of affixing a word, sufficiently preserve a distinctive character: and these names are much better than others, more regular perhaps, but far less consentaneous to general use, which could be constructed.

In selecting names, I have taken those which appeared to be in the most general currency, without regarding whether they were domestic or foreign, existing in common language or invented by mineralogists; or whether their reference was to external character, as colour and crystallization; or to chemical constitution; or to any circumstance in the history, use, or locality of the mineral; or whether finally, they were altogether arbitrarily imposed.

It may perhaps not be superfluous to observe, that the names thus proposed are not to be looked upon as *definitions,* or as in themselves demonstrably better than any other names. It is no objection to the use of such a word as *Augite* for a certain mineral, that other minerals are equally *splendent;* or to *Albite* and *Leucite,* that they are etymologically the same. Words are to be considered not as definitions, but as *memorandums,* and any name is good which is analogical and easily remembered; the care of accurately defining its application devolving upon the teachers of the science. Much inconvenience and confusion have arisen from attempting to make words more significant in the way of description than they can be. It is well to have appropriate names; but it is by no means a reason for superseding a name well established, that we can point out another somewhat more appropriate. Where a slight alteration will make a word conform to *analogy,* it is desirable to introduce the change: and in scientific language this seems to be a duty. But it is highly unphilosophical, as well as extremely inconvenient, to require that every part of the name shall have a definite value in enabling us to discriminate the species without a previously acquired knowledge of them.

If it be necessary to invent new names in future, as it probably will be, the task ought to be more carefully executed by mineralogists than it has hitherto generally been. An unscrupulous recourse to Greek words and their combinations, seems by no means to be recommended, especially when it is considered how frequently this has been practised in violation of the analogies of language. Many of Haüy's names are injudicious in another way; they refer to distinctions among such minerals as had previously been confounded; and in these cases, when the confusion was removed and forgotten, the origin of the name became obscure, and the term often appeared in the highest degree fantastic. Thus *Idocrase* (Vesuvian) is so called, because its *form* is *mixed* of those of Zircon, Harmotomite, and Scapolite. *Meionite,* (Scapolite,) has its name from having a lower or *less* pyramid than Idocrase. *Mesotype* (Mesolite) has a *mean form* between Cubicite and Stilbite: and so in a variety of other cases. Where these names have taken root, they are become good names, but it would seem that it is not advisable to add to the number of such.

It would appear also, that if the advantages of the following system are to be aimed at, we ought not to form new names for minerals of all kinds indiscriminately, by selecting a word, and terminating it in *ite* or *lite.* This process should be confined to substances which are of the Order *Lite.* In the same manner the termination *ine* which has been used, seemingly only for the sake of variety or euphony, should, if employed at all, be appropriated. I have used it, or something resembling it, for all the species of the *Garnet* family.

The preceding observations are all which are necessary for the understanding of the arrangement contained in the following pages. But it may still be of interest to some to add a few words respecting the principles on which that classification is founded with which the results of Chemistry are now to be compared.

SECT. V.

ON THE NATURAL METHOD OF CLASSIFICATION IN MINERALOGY.

When we endeavour to classify any of the kingdoms of the natural world, perhaps the method which first suggests itself, is to arrange them into divisions according to some assumed mark, universally and easily applicable: such as, for instance, the number of stamens in a flower; or such as the cleavage, or crystalline form might be in minerals. It is found however, with respect to such methods, that they can never be carried through without violating materially those natural relationships and family resemblances among different kinds of individuals, which an acquaintance with the objects forces irresistibly upon our notice. And it appears that in order to preserve unbroken those obvious alliances, we must adopt another and different mode of classifying. We must, it is found, take the *total* resemblances and differences of different species in order to determine their places. We must take *all* the properties and analogies which the objects exhibit, and follow in each case those of them which seem decidedly and permanently to bind groups together. Thus, the forms and number of the parts of the flower, the nature and divisions of the fruit, the position of one or the other, and a variety of circumstances with respect to the leaves, &c. all contribute to characterize the natural orders and genera of plants. And of these marks, several may lose their value, being found not to be permanent or resembling in the related species; and leaving the propinquity to be established by the remaining properties. And it does not appear possible to fix beforehand which of such attributes shall be considered as decisive.

In the same manner we may take the assemblage of *all* the properties of a mineral: its hardness, specific gravity, crystallization, cleavage, lustre, colour, and other accidents; and we may associate our classes according to those groups of such qualities, which seem most to stamp a permanent family character upon them.

Now it will probably occur to any one to whom this view of the subject is new, that we appear to incur a very inconvenient degree of vagueness and uncertainty by this principle; for how are we to measure the total resemblances of objects? or by what criterion can we decide whether or not a species is to be placed in a certain class? And in answer to this objection, it must be acknowledged that the mineralogist will have to determine the class of a mineral, not by any technical rule, but by his acquaintance with all its leading properties; and he will be the more certainly right as his knowledge of these is more accurate. And the indefiniteness which is thus complained of, exists, and must exist in all classifications which aspire to be natural; and yet has not prevented natural historians from arriving at unanimity and certainty, with respect to the greatest part of their subdivisions. No Botanist at present doubts with respect to the existence of natural *orders;* natural *genera* are still more undeniable. And yet these divisions are not established by any previously assumed criterion, but by observing the general leading of the qualities of plants. And something similar happens even in other sciences which pretend to a more systematic exactness. How are we to distinguish by any one unerring test, that which is a metal, or an acid, or an alkali? And yet these are important divisions in Chemistry. Both Beudant, Thenard, and Gmelin, have indeed begun their chemical classifications by arrangements of the elementary substances, which, so far as they are not arbitrary, depend upon principles affected with this very indefiniteness. And it seems capable of being demonstrated, that if our studies are to have for their object the knowledge of substances as they actually occur in nature, no principle assumed *a priori* can be a proper guide.

By the observation of such total resemblances and differences as have been spoken of, the species of minerals were arranged into a connected system; and this having been done, certain discriminating *characters* were selected by which we might recognize in each mineral the place which it occupied in the system, as is done in Botany. The principal works in which such an arrangement has been offered to the world, are those of Mohs and of Breithaupt. Both the original sketches of these authors were hence termed, "Characteristik," "The Characteristics of the Mineral Kingdom," and they contained an enumeration of the distinctive properties in minerals by which they might be distributed successively into their classes, orders, genera, and species; these divisions having been previously established by the authors according to their views of the most important analogies of the individuals.

Perhaps some may be disposed to object that we are here attempting to push too far the analogy of Botany and Mineralogy: that this analogy is very imperfect: that we have no ground to assume that the sciences are to have the same form and rules: that plants differ from minerals in the most essential points with which a system is concerned: that the principle of organic life which belongs to the former, and their consequent existence as individuals, separate them altogether from the physical aggregations of mineralogy, and demand a quite different mode of considering them. To this it may be replied, that without resting on the analogy of Botany and Mineralogy, if a classification in the latter science depending upon external characters alone, should lead to an arrangement which has also a chemical signification, it would have at least a claim to be further examined. But we might venture to go beyond this position. We might say that minerals have also *their* principle of union, by which they are distinguished from mere mechanical aggregates.—That the powers of crystallization bind their parts together in a manner which produces a permanency (within certain limits) in the qualities of the same species, and gives individuality, or something nearly equivalent, to the separate objects.—That a crystal of calc-spar is something different from carbonate of lime in powder, or in an uncrystalline form; and that it seems absolutely necessary, in arranging minerals, to take into account those qualities by which they are minerals; that is, bodies possessing certain determinate properties. It might be added, that those properties do afford us the means of arranging the individual objects in mineralogy, according to their first, second, &c. degrees of resemblance, into species, orders, &c. And that if we follow this process with patience and caution, we find ourselves led to rules of system and language resembling those of Botany, without having previously prescribed such to ourselves.

The use and convenience of such a classification in mineralogy as that of which we now speak, are, supposing it established, sufficiently obvious. Bodies being thus distributed, the description of the class would of itself contain much that now must necessarily be repeated for each species; and considerable information would be conveyed by the name of the species alone. This advantage is so great, that it has induced Thenard to employ the method even in Chemistry. He has, as he says, united in the same group analogous bodies; metals; metallic oxydes; &c. "L'avantage de cette methode," he observes, "employée par les "naturalistes, se fera sentir surtout dans l'étude des metaux "et des composés dont ils font partie. En effet il est possible "de faire de ces sortes de corps une étude generale si precise, "qu' on soit presque dispensé de les etudier en particulier." Pref. p. viii.

We might argue also, that if we hope to obtain any chemical knowledge of minerals, such knowledge is only conceivable on the supposition that we can determine minerals by characters which do *not* depend on Chemistry. If we assert that Arragon Spar always contains Strontia, the assertion is only intelligible on the supposition that Arragon Spar refers to a distinguishable species. If the chemical name or chemical formula is the *definition* of the species, it can no longer be a *proposition* concerning the species. If the mineralogist is to ask information of the Chemist, he must ask it respecting objects which he knows, and can recognize and describe in his own way; and he must then examine what facts and what laws are indicated by the information which he thus receives.

If, having formed such a classification independently of Chemistry, and compared it with the results of chemical analysis, we do find any general chemical properties which prevail in our mineralogical classes; whether they depend on the kind or number of the ingredients, the proportion and manner of their combination, or on any other properties: it is manifest that these laws then contain important and curious knowledge concerning the connexion between the chemical constitution and the physical properties of the substances. If we can find with what differences of analysis sulphur and sulphur-like elements when combined with a metal, make it—sometimes very hard and of a bright yellow or white metallic aspect, (Pyrites)—sometimes much softer and of a grey and leaden appearance, (Glance)—sometimes again of splendid unmetallic colours, and of adamantine lustre (Blende)—we shall then have added to our knowledge of chemical laws, as well as assigned the ingredients of a few given minerals. It is from the chemical study of Mineralogy in the point of view in which it is the object of this essay to place it, that we may look for the growth of such knowledge: and apparently we can hope for it in no other way.

It has already been intimated that the principle of union in minerals, and that by which they are distinguished from mere chemical products, is *crystallization.* It would follow from this, that strictly speaking, Mineralogy is not called upon to classify objects except where the principle of crystallization has in some manner acted. It would also follow, that all substances which are crystallized, artificial as well as natural, do belong to our system, and should find a place in our classes. Indeed, the difference between natural and artificial crystallized substances, depends upon our not being able to imitate the circumstances under which nature has produced her results; and is every day diminishing as philosophers make a progress in doing this. By admitting all artificial crystals into the system, we should have a very considerable addition to our number of species, and very probably one which would throw much light on our science, inasmuch as the composition of such substances might be very accurately known. This part of the subject seems at present to be advancing greatly, and has excited the attention of very able mineralogists; but apparently the knowledge which we at present possess of it is not sufficient to make it proper to attempt as yet to incorporate it in our system. Probably the greatest additions thus to be made, will fall upon the orders of *Salts* and *Spars*. But it is impossible to foresee how far we may hereafter succeed in imitating the composition of all the other orders. It would be as unworthy to despair of the results of observation and sound theory, as it would be unwise to attempt to anticipate them by conjecture.

SECT. VI.

ON THE DIVISIONS PROPOSED IN THE FOLLOWING TABLES.

A FEW observations remain to be made on the rules adopted in the following Tables.

1. The only degrees of classification which are admitted, are *Order* and *Species;* omitting the higher rank of *Class* and the intermediate one of *Genus*. The former is not introduced at present; but its lines may be drawn when the subordinate divisions are finally settled; and it may be proper for such a purpose to add to the system some orders here omitted, such as *Acid*, *Resin*, *Coal*. With respect to the union of species into *Genera*, employed both by Mohs and by Breithaupt, it is not intended by omitting them to deny their validity. But it seemed allowable at any rate to neglect them for the present, as not essential either to the nomenclature or to the proof of the system. The names formed by following the analogy of Botany in this respect, are far less convenient than those depending on the order and the species alone; as they are here given. And if the chemical peculiarities of the orders be once established, their subdivisions may afterwards be considered.

2. I have however pointed out, subordinate to the orders, certain collections possessing very prominent resemblances, which I have termed *Families*, as the Garnet Family, the Feldspar Family, the Hornblende Family, &c. some of which agree with the genera of the writers above referred to. Thus the Zeolite Family and the Garnet Family agree with the genera Kouphone Spar and Garnet of Mohs. I have also been necessarily led, by the chemical formulæ offered by the analyses of bodies, and by the isomorphous substitutions occurring in them, to join several kinds of minerals into one assemblage or *Group*, without pretending to decide whether the

members of such groups are to be considered as separate species, or as different varieties of the same species. Thus the different kinds of Dodecahedral Garnet,—Alamandine, Grosuline, Aplome, Melane (Melanite,) &c.—differ in their composition, though they seem to pass into one another without any interruption like the boundary of a species. This state of our knowledge seems to suggest several questions which must be considered as at present not decided. And so far should we be from attempting to compel Mineralogy to conform to the shape which other branches of Natural History have assumed, that it is perhaps not too much to say that we may here be, as yet, ignorant of the nature of the divisions, which will at last be found to be the true ones. That is, we may find that species hitherto assumed as different, graduate into one another, either by determinate steps or by insensible shades, and that they are held together in groups by this gradation and the chemical formula, which is common to them all. We may find that several such formulæ, with some common analogy or connexion, constitute a family, and such families may or may not be subordinate to the orders suggested in the following pages. In a subject so different as this is from Botany, or any other part of Natural History, we are not to be surprised if the very nature of the subdivisions of genus and species assume a new meaning and character.

3. The Orders here adopted are in the main those of Mohs. But various changes are proposed, such as were irresistibly suggested by the appearances of the system. These however are seldom introduced as parts of the system, except when they are countenanced by the views of other respectable mineralogists. It was not my purpose, even if my acquaintance with Mineralogy and Chemistry had entitled me to do so, to frame a system of my own, and to correct previous writers; but simply to shew the results of a comparison of two different methods: and for this task no profound knowledge of either science is required. Wherever I have deviated from Mohs in the mineralogical arrangement, I have given my authority or reasons, and have marked the result which I have adopted with the measure of doubt or probability which seemed to belong to it. I have however without scruple altered his arrangement of species in each order, whenever it appeared that by doing so, the analogies became more obvious.

4. The situations of some of the species in the following system must still be considered as uncertain, and the character

and limits of some of the orders as not finally settled. This is inevitable in a first attempt of this kind, and it cannot be otherwise while both our mineralogical and chemical knowledge of many species is so imperfect. In order to be quite sure of the form and details of our classification, it would be necessary to be acquainted with each mineral under all its leading varieties of appearance and occurrence; and to have accurate analyses, not of one or two specimens only in each case, but of so many and of such varieties, as to detect all the disguises which might result from isomorphism, accidental mixture, or any similar cause. The carrying to perfection the mineral system, considered as the combination of chemical and mineralogical knowledge, is the object which ought to be kept before the eyes both of Mineralogists and Chemists in their researches, and this course, as has already been said, may be expected to give us finally an insight into the laws and principles, such as undoubtedly do exist, though not yet discovered, by which the chemical constitution of substances is connected with their physical properties.

SECT. VII.

EXPLANATION OF THE TABLES OF THE ORDERS AND SPECIES OF MINERALS.

The *first* column contains the reference to the description of the species as given in the translation of Mohs's Mineralogy.

The *second* contains the systematic *name* now proposed; with the names, not systematized, of some other species of which the situation did not seem sufficiently certain, and which are printed in a different character.

The *third* and *fourth* columns contain the determination of the *hardness* (*H*) of the minerals according to the scale of Mohs, and of their *specific gravity* (*G*). These determinations are in most cases taken from the Mineralogy of Mohs. The numbers separated by a double dot, represent the limits of these properties for the species.

The *fifth* column exhibits the chemical constitution of the species expressed in the notation which has already been explained. The authorities for this, generally Beudant or Berzelius, have been followed with no other alteration than was requisite for the purpose of making the notation uniform.

The *sixth* column contains these authorities. Beudant is referred to by the contraction Bdt. and the page. Berzelius, accordingly as the reference is to his Neues System der Mineralogie, (Nürnberg, 1816) or to the Zeitschrift für Mineralogie (1825, September) is marked Berz. *N. S.* or Berz. *Z.* with the number of the page. The other authorities here quoted will be easily understood.

The remaining part of the page contains the synonyms of other authors for the species opposite, and any observations which seemed to tend to illustrate or justify the classification and names adopted. The leading synonym is always, where it could be selected, that of Phillips, and a reference is made to the page of his Mineralogy where it occurs. The names which are taken from other authors are printed in Italics.

I have here subjoined the scale employed by Mohs, and adopted in the Tables, for designating numerically the hardness of minerals. See his Mineralogy, Vol. I. p. 301.

I have also subjoined a tabular view of the chemical notation employed, and I have annexed the weight of the atoms of different substances as given by Beudant. The weight of the atom of oxygen is here taken to be 100. By means of these numbers, the quantitative analysis of any mineral may be reduced to its proper formula.

In the case of the combinations of fluoric and muriatic acid, the theory adopted by Beudant has led him to expressions different from those here given. In these instances we may consider the mode of exhibiting the results as provisionary only, till the best and simplest view is definitively ascertained.

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TABLE OF THE DEGREES OF HARDNESS OF MINERALS, (Mohs.)

H		
1	TALC.	Whitish or Greenish varieties.
2	GYPSUM SALT.	*Gypsum* or *Hydrous Sulphate of Lime*, imperfectly cleavable and uncrystallized.
	ROCK SALT.	*Muriate of Soda.*
3	CALC SPAR.	*Carbonate of Lime.* Any cleavable variety.
4	FLUOR SPAR.	*Fluate of Lime.* Any cleavable variety.
5	PHOSPHOR SPAR.	*Apatite. Asparagus Stone.* The varieties from Salzburg.
6	ORTHOKLASITE LABRADORITE ANORTHITE	Kinds of Prismatic Feldspar. Cleavable varieties of *Adularia.*
7	QUARTZ.	Limpid and transparent varieties.
8	TOPAZ.	Any simple variety.
9	CORUNDUM.	The cleavable variety from Bengal.
10	DIAMOND.	

Intermediate degrees are marked by the intermediate numbers 1.5, 2.5, 3.5, &c.

TABLE OF CHEMICAL NOTATION and of the Weights of the Atoms of the Elements of Bodies: the Weight of the Atom of Oxygen being 100. (Beudant.)

1st CLASS. *Metals of Earths.*

	Sign.	Weight.
SILICIUM	S	296.42
Silica	$\dddot{S}$	596.42
ZIRCONIUM	Z	
Zirconia	$\dddot{Z}$?	
THORINIUM	Th	
Thorinia	$\dddot{Th}$?	
ALUMINUM	A	342.32
Alumina	$\dddot{A}$	642.32
YTTRIUM	Y	805.14
Yttria	$\ddot{Y}$	1005.14
GLUCINIUM	G	662.56
Glucina	$\dddot{G}$	962.56
MAGNESIUM	M	316.72
Magnesia	$\dddot{M}$	516.72

2nd CLASS. *Metals of Alkalis.*

CALCIUM	C	512.06
Lime (*Calcia*)	$\ddot{C}$	712.06
STRONTIUM	Sr	1094.60
Strontia	$\ddot{Sr}$	1294.60

	Sign.	Weight.
Barium	B	1713.86
Baryta	$\ddot{B}$	1913.86
Lithium	L	255.63
Lithia	$\ddot{L}$	455.63
Potasium (*Kalium*)	K	879.83
Potassa	$\ddot{K}$	1079.83
Sodium (*Natron*)	N	581.84
Soda	$\ddot{N}$	781.84

3rd Class *of Metals.*

Zinc	Zi	806.45
Oxide of Zinc	$\ddot{Zi}$	1006.45
Iron (*Ferrum*)	Fe	678.43
Bioxide of Iron	$\ddot{Fe}$	878.43
Trioxide ———	$\dddot{Fe}$	978.43
Tin (*Stannum*)	Sn	1470.58
Oxide of Tin	$\ddddot{Sn}$	1870.58
Cadmium	Cd	1393.54
Oxide of Cadmium	$\ddot{Cd}$	1593.54

4th Class *of Metals.*

Arsenic	As	940.77
Arsenious Acid	$\dddot{As}$	1240.77
Arsenic Acid	$\overset{\substack{\cdot\cdot\\\cdot\cdot\cdot}}{As}$	1440.77
Molybdenum	Mo	596.80
Molybdic Acid	$\dddot{Mo}$	896.80

	Sign.	Weight.
Chrome	Cr	703.64
Oxide of Chrome	$\overset{\cdots}{Cr}$	1003.64
Chromic Acid	$\overset{\substack{\cdots\\\cdots}}{Cr}$	1303.64
Tungsten (*Wolfram*)	W	1207.69
Tungstic Acid	$\overset{\cdots}{W}$	1507.69
Tantalum	Ta	3646.30
Tantalic Acid	$\overset{\cdot\cdot}{Ta}$	3846.30
Antimony (*Stibium*)	St	1612.90
Antimonious Acid	$\overset{\cdot\cdot\cdot\cdot}{St}$	2012.90
Antimonic Acid	$\overset{\substack{\cdot\cdot\\\cdot\cdot\cdot}}{St}$	2112.90
Titanium	Ti	778.20
Titanic Acid	$\overset{\cdot\cdot\cdot\cdot}{Ti}$	1178.20
Uranium	U	3146.86
Bioxide of Uranium	$\overset{\cdot\cdot}{U}$	3346.86
Trioxide ———	$\overset{\cdots}{U}$	3446.86
Cerium	Ce	1149.44
Oxide of Cerium	$\overset{\cdot\cdot}{Ce}$	1349.44
Cobalt	Co	738.00
Bioxide of Cobalt	$\overset{\cdot\cdot}{Co}$	938.00
Trioxide ———	$\overset{\cdots}{Co}$	1038.00
Bismuth	Bi	1773.80
Oxide of Bismuth	$\overset{\cdot\cdot}{Bi}$	1973.80
Copper (*Cuprum*)	Cu	791.39
Oxide of Copper	$\overset{\cdot}{Cu}$	891.39
Bioxide ———	$\overset{\cdot\cdot}{Cu}$	991.39

	Sign.	Weight.
Nickel	*Ni*	739.51
Oxide of Nickel	$\ddot{Ni}$	939.51
Lead (*Plumbum*)	*Pb*	2589.00
Oxide of Lead	$\ddot{Pb}$	2789.00
Tellurium	*Te*	806.45
Selenium	*Se*	495.91

5th Class *of Metals.*

Osmium	*Os*	
Mercury (*Hydrargyrum*)	*Hg*	2531.60

6th Class *of Metals.*

Silver (*Argentum*)	*Ag*	2703.21
Palladium	*Pd*	1407.50
Rhodium	*Rh*	1500.10
Platinum	*Pt*	1215.23
Gold (*Aurum*)	*Au*	2486.00
Iridium	*Ir*	

Bases of Acids.

Boron	*b*	69.65
Boracic Acid	$\ddot{b}$	269.65
Carbon	*c*	75.33
Carbonic Acid	$\ddot{c}$	275.33
Sulphur	*s*	201.16
Sulphurous Acid	$\ddot{s}$	401.16
Sulphuric Acid	$\dddot{s}$	501.16

	Sign.	Weight.
PHOSPHOR	p	392.30
Phosphoric Acid	$\overset{\substack{\cdot\cdot\\\cdot\cdot\cdot}}{p}$	892.30
AZOTE (*Nitrogen*)	n	177.26
Nitric Acid	$\overset{\substack{\cdot\cdot\\\cdot\cdot\cdot}}{n}$	677.26
FLUOR	f	75.03
Fluoric Acid (Phtore, Bdt.)	$\ddot{f}$	275.03 472.76
HYDRO-MURIATIC ACID (Hydro-Chloric Acid Bdt.)	$\overset{\cdot\cdot\cdot\cdot}{m}$	227.55
MURIATIC ACID (Chlore, Bdt.)	$\ddot{m}$	221.33
WATER 1 Atom Oxygen + 2 Atoms Hydrogen.	q	112.44
AMMONIA 1 Atom Nitrogen + 6 Atoms Hydrogen.	Am	214.56
HYDROGEN		6.22

Probably Sulphur, Phosphor, Chlore, Phtore, should be placed along with Tellurium and Selenium: perhaps near the Metals in the first division of the 4th Class, which form Acids. See Bdt. 320.

Carbon and Boron have some analogies with Silicum ~~Selenium~~, Bdt. 319.

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TABLES

OF THE

ORDERS AND SPECIES

OF

MINERALS.

ORDER I. SALT.

THE *order* SALT does not occur very prominently in nature, as its species, from their softness and the loose combination of their elements, are not very durable. And as the species are also rather numerous, and not well distinguished and determined, the reader may perhaps find it easier to begin his examination of the system with the succeeding order (Spar). The greater part of the minerals in this order are however sufficiently characterized by their small degree of hardness, specific gravity, crystalline texture, and other qualities. In chemical composition they consist either of combinations of an alkali with an acid, or hydrous combinations of an earth with an acid. The presence of the water in the latter case seems to distinguish between this class and the next; the difference of chemical composition, as in the case of *Gypsum Salt* and *Gypsum Spar*, being accompanied by a remarkable difference in hardness and other qualities. Most of the artificial crystals will probably belong to this order, and by the study of them great light may hereafter be thrown upon its laws. Among the minerals which we find here, the *Vitriols* and the *Alums* form two remarkable groups with curious isomorphic relations.

The name Salt is generally given to such chemical combinations as are now to be designated. And as it is here applied, the *names* of the different SALTS are in many cases the usual names, and the other terms in the following list seem to be very natural denominations for the substances spoken of.

Mohs has given an order ACID separate from the Salts; but for mineralogical purposes, this seems, for the present, to be perhaps unnecessary.

ORDER I. SALT.

FIRST ISOMORPHOUS GROUP. VITRIOL.

		H	G	
M. II. 41	IRON VITRIOL SALT	2.0..2.5	1.8..2.3	$\ddot{Fe}+2\dddot{s}+14q$
	GREEN ——			$\ddot{Fe}+2\dddot{s}+12q$
	RED ——			$3\ddot{Fe}+4\dddot{s}+6(\dddot{Fe}+2\dddot{s})+72q$
	OCHRE ——			$2\ddot{Fe}+\dddot{s}+6q$
44	BLUE VITRIOL SALT	2.5	2.2..2.3	$\ddot{Cu}+2\dddot{s}+10q$
	——			$3\ddot{Cu}+2\dddot{s}+6q$
46	WHITE VITRIOL SALT	2.0..2.5	2.0..2.1	$\ddot{Zi}+2\dddot{s}+12q$
III. 145	RED VITRIOL SALT			$\ddot{Co}+\dddot{s}+9q$?
—	URAN VITRIOL SALT			$\dddot{U}+\dddot{s}+xq$

SECOND ISOMORPHOUS GROUP. ALUM.

		H	G	
M. II. 50	ALUM SALT	2.0..2.5	1.7..1.8	
	——			$2(\dddot{A}+3\dddot{s})+\ddot{K}+2\dddot{s}+48q$
	——			$2(\dddot{F}+3\dddot{s})+Am+2\dddot{s}+48q$
	——			$2(\dddot{Fe}+3\dddot{s})+\ddot{K}+2\dddot{s}+48q$
	——			$2(\dddot{Fe}+3\dddot{s})+Am+2\dddot{s}+48q$
	——			$2(\dddot{Mn}+3\dddot{s})+Am+2\dddot{s}+48q$
	——			$2(\dddot{Cr}+3\dddot{s})+Am+2\dddot{s}+48q$
	——			$2(\dddot{Cr}+3\dddot{s})+\ddot{K}+2\dddot{s}+48q$
	——			$\dddot{A}+3\dddot{s}+12q$
	——			$\dddot{A}+3\dddot{s}+\ddot{Fe}+2\dddot{s}+28q$?

FORM OBLIQUE PRISMATIC.

Bdt 447	*Couperose.* Sulphate of Iron, P. 240. Hemiprismatic. Mohs.
Berz. Z. 213	
Berz. Z. 213	Bdt speaks of a mixture of $3\ddot{Fe}+4\dddot{s}$ and $\ddot{Fe}+2\dddot{s}$ with much water.
Berz. Z. 213	*Pittizite. Fer Oxidé Resinite.*
Bdt 447	
Bdt 448	*Blue Vitriol.* Sulphate of Copper, P. 240. Tetarto-prismatic. Mohs. *Hydro-trisulfate de cuivre.* Bdt.
Bdt 448	*Hydrosulfate de cuivre.* Bdt.
Bdt 446	*Gallizinite. White Vitriol.* Sulphate of Zinc, P. 356. Prismatic. Mohs.
Bdt 446	Red Vitriol. Sulphate of Cobelt, P. 282.
Berz. Z. 213	*Sulfate d'Urane* Bdt. 448.

FORM REGULAR OCTAHEDRAL.

	Alum, P. 196.
Bdt 450	*Alun Potassé.* Bdt.
Bdt 451	*Alun Ammoniacal.* Bdt.
	According to Mitscherlich (Ann. de Chemie t. xix. p. 381.) all these combinations have been observed, crystallized in regular octahedrons. Probably they are not mineralogically separate species.
	This was discovered by Faraday. See Mitscherlich.
Bdt 449	*Hydro-trisulfate d'alumine.*
Bdt 451	*Alun de Plume. Sulfate double d'alumine et fer.*

ORDER I. SALT.

		H	*G*	
M. III. 70	ALUM-STONE SALT	..20	1.6..1.7	$20(\dddot{A}+\dddot{s})+$ $3\ddot{K}+4\dddot{s}+42q$
	WEBSTER SALT			$\dddot{A}+\dddot{s}+9q$
125	MASCAGNINE SALT			$Am+\dddot{s}+2q$
II. 39	AMMONIAC SALT	1.5..2.0	1.5..1.6	$Am+\ddddot{m}$
36	ROCK SALT	2.0	2.2..2.3	$[N+2ch]$ $[N+4ch]$ $\ddot{N}+3\ddot{m}$
	MAGNESIA SALT			$M+2\ddot{m}$
34	NITRE SALT	2.0	1.9..2.0	$\ddot{K}+2\overset{\cdot\cdot}{\dddot{n}}$
III. 132	SODA SALT	1.5..2.0	2.0	$\ddot{N}+2\overset{\cdot\cdot}{\dddot{n}}$
II. 52	BORAX SALT	2.0..2.5	1.7..1.8	$\ddot{N}+8\ddot{b}+24q$ $\ddot{N}+2\ddot{b}+10q$ $\ddot{N}+6\ddot{b}+18q$
27	NATRON SALT	1.0..1.5	1.4..1.6	$\ddot{N}+2\ddot{c}+2q$
29	PRISMATIC NATRON SALT	1.5	1.5..1.6	$\ddot{N}+2\ddot{c}+xq$
III. 164	TRONA SALT	2.5..3.0	2.1	$\ddot{N}+3\ddot{c}+4q$
II. 31	GLAUBER SALT	1.5..2.0	1.4..1.5	$\ddot{N}+2\dddot{s}+20q$
54	GLAUBERITIC SALT	2.5..3.0	2.7..2.9	$(\ddot{N}+2\dddot{s})+(\ddot{C}+2\dddot{s})$
III. 159	POTASSA SALT	2.5..3.0	1.7	$\ddot{K}+2\dddot{s}$
79	BLOED SALT	soft		$\ddot{M}+2\dddot{s},\ \ddot{K}+2\dddot{s},$ $\ddot{N}+3\ddot{m}$
	REUSSINE SALT			$\ddot{M}+2\dddot{s}+$ $\ddot{K}+2\dddot{s}+32q$

Bdt 450	Aluminite. Subsulphate of Alumine, P. 145.
Bdt 449	*Websterite. Hydrosulfate d'alumine.*
Bdt 444	*Mascagnine. Sulphate of Ammonia.*
Bdt 454	*Sal Ammoniac.* Muriate of Ammonia, P. 154. [$Az+6H+Hch$, Bdt. I put $\overset{\cdot\cdot\cdot\cdot}{m}=Hch$ and $Am=Az+6H$].
Berz. Z.213 Bdt 453 Mohs	Common Salt. Muriate of Soda, P. 193.
Berz. Z.213	*Muriate of Magnesia.* Berz. [$M+2ch$]
Bdt 421	Nitre. Nitrate of Potash, P. 189.
Bdt 421	Nitrate of Soda, P. 191.
Mohs	Tincal. Borax. Borate of Soda, P. 192.
Mohs	Artificially crystallized Borax Salt.
Bdt 394	
Mohs	Natron. Carbonate of Soda, P. 190. Hemisprimatic. Mohs.
Mohs	This differs from the preceding species in containing a smaller quantity of water.
Mohs	Trona, P. 190.
Bdt 444	Glauber Salt. Sulphate of Soda, P. 191.
Bdt 444	Glauberite, P. 198. Sulphate of Soda and Lime.
Bdt 443	Sulphate of Potash.
Mohs	Bloedite, P. 199.
Bdt 445	*Réussine. Double sulfate de soude et magnésie.* Bdt.

ORDER I. SALT.

		H	G	
M. 141	POLYHALOUS SALT	3.0..	2.77	$\ddot{M}+2\dddot{s}+\ddot{K}+2\dddot{s}+2(\ddot{C}+2\dddot{s})+4q$
II. 48	EPSOM SALT	2.0..2.5	1.7..1.8	$\ddot{M}+2\dddot{s}+12q$
57	GYPSUM SALT	1.5..2.0	2.2..2.4	$\ddot{C}+2\dddot{s}+4q$

The following may most properly be referred to this Order.

M. II. 25	BORACIC ACID		1.4..1.5	$\ddot{b}+2q$
26	ARSENIC ACID	1.5	3.6..37.	$\dddot{As}$

Berz. Z.212 Polyhalite, P. 199.

Bdt 445 *Epsom Salt.* Sulphate of Magnesia, P. 180.

Bdt 443 Gypsum. Sulphate of Lime, P. 174. Mohs places this substance among the Spars, but both its hardness and its composition seem to indicate this as a more appropriate place. If it were placed among the Spars, *Soft Gypsum Spar* and *Hard Gypsum Spar* might be used as names for this species and for $\ddot{C} + 2\dddot{s}$.

Sassoline. Native Boracic Acid, P. 144.

Bdt 470 *Arsenic blüthe. Acide Arsenieux.* Bdt.

Snow is placed by Breithaupt among the Salts.

ORDER II. SPAR.

THE *order* SPAR is, when taken in a general view, sufficiently distinct and connected. It consists of bodies a good deal resembling many artificial salts in transparency, lustre, streak, cleavage, &c. Its members are however generally decidedly harder and heavier than the salts. In chemical composition also, the spars and salts resemble each other considerably, each containing an *earth* or *quasi-earth* combined with an *acid*. But in the case of the salts we generally have, besides these, *water* as an element, at least when the earths enter; and this difference seems to be connected with the difference of physical properties above-mentioned. The spars are also in general such combinations as are either not at all or not easily produced in the laboratory, though abundant and universal in nature.

There are several very remarkable *groups* of minerals in this order, in which groups the base or earthy element may consist of different substances while the crystallization and other chemical properties remain very nearly the same. Thus it appears that in the group of which Calc Spar is a member, the elements $\ddot{C}$, $\ddot{M}$, $\ddot{Fe}$, $\ddot{Mn}$, $\ddot{Zi}$, may replace each other without producing any change greater than about $2\frac{1}{2}^{0}$ in the angle of the rhombohedron; with an alteration of the hardness from 3.0 to 5.0 and of the specific gravity from 2.7 to 4.4; the minerals in other respects retaining the strongest resemblance and almost identity. In the same manner we have a group connected with Heavy Spar, where the earthy ingredient may be $\ddot{B}$, $\ddot{Sr}$, $\ddot{Pb}$, and the acid $\ddot{c}$ or $\dddot{s}$, the properties remaining remarkably constant. Perhaps other such groups may be discovered.

The species of this order form in Mohs's system two orders, Haloide and Baryte, distinguished principally by the great specific gravity of the latter. This division is however in some respects inconvenient, both in consequence of the similar chemical constitution of the two orders, and because this subdivision would disperse into these different orders different members of one of the isomorphous groups which I have mentioned, and which every analogy requires us to keep united.

The *name* SPAR in English seems in common language to convey the idea of a transparent, crystalline, cleavable substance of no great hardness. It has been familiarly used to designate a great number of the species of this order; Calc Spar, Bitter Spar, Sparry Iron, Fluor Spar, Heavy Spar, &c. being all terms usually employed. Hence it will not perhaps produce any serious inconvenience from the novelty of the names, if all of them are so modified as to assume the same form. The names here adopted are in most cases such as to contain an obvious memorandum of the name hitherto most common for the same substance.

Mohs has I think been unfortunate in his employment of the word *Spar* (to which apparently the German *Spathe* pretty accurately corresponds.) Thinking it proper, according to his rules, that the minerals belonging to the order Spar should have names ending with that word, and considering Felspar as the best established of such names, he fixed that order to be Spar to which this mineral belonged: neglecting the greater number of instances above referred to in which such names belong to another order, and in which the word is applied with more significance. The names which Mohs uses for this order are *Haloide,* implying the resemblance to the *Salts,* and *Baryte* which indicates the considerable specific gravity of the minerals. Breithaupt employs for the whole of it the word *Spathe,* corresponding to the name which we have adopted.

ORDER II. SPAR.

		H	G	
M. II. 62	GYPSUM SPAR	3.0..3.5	2.7..3.0	$\ddot{C}+2\dddot{s}$
79	ARRAGON SPAR	3.5..4.0	2.6..3.0	$\ddot{C}+2\ddot{c}$ $\ddot{Sr}$

FIRST ISOMORPHOUS GROUP. FORM RHOMBOHEDRAL.

M. II. 83	CALC SPAR	3.0	2.5..2.8	$\ddot{C}+2\ddot{c}$
93	BITTER SPAR	3.5..4.0	2.8..3.0	$\left.\begin{matrix}\ddot{C}+2\ddot{c}\\+\ddot{M}+2\ddot{c}\end{matrix}\right\}$
98	RHOMB SPAR	4.0..4.5	3.0..3.2	$\ddot{M}+2\ddot{c}$ $\ddot{Fe}$
101	IRON SPAR	3.5..4.5	3.6..3.9	$\ddot{Fe}+2\ddot{c}$
106	MANGANESE SPAR	3.5	3.3..3.6	$\ddot{Mn}+2\ddot{c}$
111	ZINC SPAR	5.0	4.2..4.5	$\ddot{Zi}+2\ddot{c}$
III. 122	MAGNESIA SPAR?	3.0..4.0	2.8	$\ddot{M}+2\ddot{c}$?

M. II. 108	*SILICEOUS ZINC SPAR*	5.0	3.3..3.6	$3\ddot{Zi}+2\dddot{S}+3q$
III. 122	*SILICEOUS MANGANESE SPAR*	5.0..5.5	3.6	$3\ddot{Mn}+2\dddot{S}+6q$
151	*SILICEOUS MAGNESIA SPAR?*	3.0	2.5..2.6	$3\ddot{M}+2\dddot{S}+3q$

Perhaps these three species may belong to another part of the system. Silica to discharge the function of an acid.

Bdt 442 Anhydrous Gypsum, P. 172, *Karstenite. Muriacite.* For Gypsum (hydrous) see the preceding Order.

Bdt 409 Arragonite, P. 161. The $\ddot{Sr}$ is always in very small quantities.

Angles of the Rhombohedrons (*A*).

		A
Bdt 406	Carbonate of Lime, P. 147. *Calc-Spar.* Aikin.	105° 5′
Bdt 410	Bitter-Spar, Pearl-Spar, Dolomite, Magnesian Limestone, P. 163, 5, 6.	106°15′
	Carbonate of Magnesia and Iron, P. 163. 378. *Rhomb-Spar.* Jam. *Rauten-spath* Germ.	107°22′
Bdt 411	Carbonate of Iron, Spathose Iron, Brown-Spar, P. 236.	107° 0′
Bdt 412	Carbonate of Manganese, P. 246.	106°51′
Bdt 412	Carbonate of Zinc, Calamine, P. 355.	107°40′
Bdt 410	Carbonate of Magnesia, P. 179. *Giobertite.* Crystallized in six-sided prisms, and therefore probably rhombohedral and belonging to this group.	107°25′

Bdt 375 Siliceous Oxide of Zinc. Electric Calamine, P. 254.

Bdt 375 Siliceferous Oxide of Manganese, P. 245. *Kieselmangan. Horn-mangan. Allagit. Photizit. Rhodonit.* Germ.

Bdt 380 Serpentine, P. 97. Placed as a Spar by Breithaupt. Supposed to include or to be connected with *Asbestus. Amianthus. Marmolite. Picrolite. Picrosmine. Pyrallolite. Steatite.* M. III. 124, 136, 137, 138, 139, 141, 157. and P. 68, 72, 118, 209.

If this be their place, it illustrates the opinion which supposes

ORDER II. SPAR.

		H	*G*	
M. II. 69	FLUOR SPAR	4.0	3.0..3.3	$\ddot{C}+\ddot{f}$ $[Ca+Ph]$
73	PHOSPHOR SPAR	5.0	3.0..3.3	$3\ddot{C}+\overset{\cdot\cdot\cdot\cdot\cdot}{p}$
III. 169	WAGNER SPAR	5.0..5.5	3.11	$3\ddot{M}+2\overset{\cdot\cdot\cdot\cdot\cdot}{p}$
II. 66	CRYONE SPAR	2.5..3.0	2.9..3.0	$\left.\begin{matrix}2\dddot{A}+3\dddot{f}+\\3\ddot{N}+\ddot{f}\end{matrix}\right\}$ $\left.\begin{matrix}\dddot{A}+2\ddot{f}+\\\ddot{N}+2\ddot{f}\end{matrix}\right\}$
67	ALUM SPAR	5.0	2.5..2.8	$\left.\begin{matrix}20(\dddot{A}+\dddot{s})+\\3\ddot{K}+4\dddot{s}+42q\end{matrix}\right\}$

SECOND ISOMORPHOUS GROUP. FORM RIGHT PRISMATIC.

M. II. 116	STRONTIA SPAR	3.5	3.6..3.8	$\ddot{Sr}+2\ddot{c}$
119	BARYTE SPAR	3.0..3.5	4.2..4.4	$\ddot{B}+2\ddot{c}$
130	WHITE LEAD SPAR	3.0..3.5	6.3..6.6	$\ddot{Pb}+2\ddot{c}$
126	CELESTINE SPAR	3.0..3.5	3.6..4.0	$\ddot{Sr}+2\dddot{s}$
121	HEAVY SPAR	3.0..3.5	4.2..4.7	$\ddot{B}+2\dddot{s}$
142	VITRIOL LEAD SPAR	3.0	6.2..6.3	$\ddot{Pb}+2\dddot{s}$

M. 159	BARYTO-STRONT SPAR	3.5	3.7	$\ddot{B}+2\dddot{s}$
II. 148	MIXED LEAD SPAR	2.0..2.5	6.8..7.0	$\left.\begin{matrix}\dddot{Pb}+2\ddot{c}\\+\ddot{Pb}+2\dddot{s}\end{matrix}\right\}$
144	TRI-MIXED LEAD SPAR	2.5	6.2..6.4	$\left.\begin{matrix}3(\ddot{Pb}+2\ddot{c})\\+\ddot{Pb}+2\dddot{s}\end{matrix}\right\}$
113	TUNGSTIC CALC SPAR	4.0..4.5	6.0..6.1	$\ddot{C}+\dddot{W}$

Berz. Z. 211	Fluor. Fluate of Lime, P. 168.
Bdt 456	
Bdt 462	Apatite Phosphate of Lime, P. 167. *Phosphorit.* Germ.
Berz. Z. 210	*Wagnerite. Phosphate of Magnesia.*
Berz. Z.	Cryolite, P. 197.
Bdt. 457	
Bdt 450	Alum Stone, P. 169.

Ob~~lique~~tuse Angles of the base of the prisms (*A*). (Phillips).

		A
Bdt 413	Carbonate of Strontian, Strontianite, P. 186.	104° 0′
Bdt 413	Carbonate of Barytes, Witherite, P. 182.	101 42
Bdt 414	Carbonate of Lead, P. 338.	103 42
Bdt 441	Sulphate of Strontian, Celestine, P. 187	117 32
Bdt 441	Sulphate of Barytes, Heavy-Spar, P. 183.	118 30
Bdt 440	Sulphate of Lead, P. 348. *Blei-Vitriol,* Germ.	117 0

Mohs	Bary-Strontianite or Stromnite, P. 187.
Mohs	Sulphato-Carbonate of Lead, P. 341.
Mohs	Sulphato-Tri-Carbonate of Lead, P. 341.
Bdt 491	Tungsten. Tungstate of Lime, P. 256. Square Pyramidal.

ORDER II. SPAR.

		H	G	
M.III.76	BARYTO-CALC SPAR	4.0	3.66	$\left.\begin{matrix}\ddot{B}+2\ddot{c},\\ \ddot{C}+2\ddot{c}\end{matrix}\right\}$
II. 151	ANTIMONY SPAR	2.5..3.0	5.5..5.6	$\dddot{Sb}$
149	CUPREOUS LEAD SPAR	2.5..3.0	5.3..5.43	$\ddot{Pb}+2\dddot{s}$ $\ddot{Cu}$ $(+q?)$
149	CUPREOUS MIXED LEAD SPAR	2.5..3.0	6.4	$\left.\begin{matrix}\ddot{Pb}+2\dddot{s}\\ \ddot{Pb}+2\ddot{c}\\ \ddot{Cu}+2\ddot{c}\end{matrix}\right\}$

M.III.165	TUNGSTIC LEAD SPAR			$\ddot{Pb}+2\dddot{W}$
II. 140	MOLYBDIC LEAD SPAR	3.0	6.5..6.9	$\ddot{Pb}+2\ddot{Mo}$
137	CHROMIC LEAD SPAR	2.5	6.0..6.1	$\ddot{Pb}+\overset{\cdot\cdot\cdot}{\overset{\cdot\cdot\cdot}{Cr}}$
133	GREEN LEAD SPAR	3.5..4.0	6.9..7.3	$\ddot{Pb}+\overset{\cdot\cdot}{\overset{\cdot\cdot\cdot}{As}}$ $\ddot{Pb}+\overset{\cdot\cdot}{\overset{\cdot\cdot\cdot}{p}}$
III. 172	YTTROCERIUM SPAR ?			$\ddot{C}+\ddot{f}$ $\ddot{Y}$ $\ddot{Ce}$
100	$3\ddot{Y}+2\overset{\cdot\cdot}{\overset{\cdot\cdot\cdot}{p}}$; $\ddot{Y}+\ddot{f}$; $2\ddot{Ce}+3\ddot{f}$; $4\ddot{Ce}+3\ddot{f}+3q$; $\underset{\ddot{Y}}{\dddot{Ce}}+\ddot{f}$; $\ddot{Ce}+2\ddot{c}$.			

Mohs	*Baryto-Calcite.* Brooke. Hemiprismatic.
Bdt 479	White Antimony. Oxide of Antimony, P. 331. Notwithstanding the dissimilarity of its chemical formula, this species appears to belong to this place.
Mohs	Cupreous Sulphate of Lead, P. 347.
Mohs	Cupreous Sulphato Carbonate of Lead, P. 342.
Bdt 415	Bdt observes that it requires more exact analysis of the two last and two next minerals to determine whether they are fixed species.
M. II. 150	*Corneous Lead. Murio-Carbonate of Lead.* Jam.
151	*Peritomous Lead Baryte.* Mohs. These two species may perhaps belong to the next order, *Horn.*

Bdt 491	Tungstate of Lead, P. 350.
Bdt 495	Molybdate of Lead, P. 348.
Bdt 496	Chromate of Lead, P. 349.
Bdt 465	Phosphate of Lead. Arseniate of Lead, P. 344, 345. *Grünbleierz.* Germ.
471	These species might seem on some account to be connected with the order of *Greens* and *Blues;* but they contain no water, which the species of that order generally do.
Berz. Z. 211	Yttrocerite, P. 265.

Berz. Z. 209 211. According to Berz. these species also occur.

ORDER II. SPAR.

The following Species, which Mohs conjectures to be of

M.III.70	*Amblygonite.*	Formerly compounded with *Scapolite.* Placed by Breith. in the *Feldspar* Family.
169	*Wavellite.*	Placed in the *Zeolite* Family by Breith. $(\overset{\cdot\cdot}{C}+2\overset{\cdot\cdot}{\overset{\cdot\cdot\cdot}{p}})$
85	*Childrenite.*	resemble Wavellite in their composition, and probably should be placed with it.
	Klaprothite.	
109	*Hopeite.*	Formerly confounded with Stilbite.

ORDER III. HORN.

THIS ORDER (*Kerate* of Mohs, *Hornerze* of Breithaupt) consists of a few species resembling each other in such a manner that the term *horn* or *corneous* has been usually applied to them. They also agree as

		H	*G*	
M.II.154	HORN SILVER	1.0..1.5	5.5..5.6	$\overset{\cdot\cdot}{Ag}+2\overset{\cdot\cdot}{m}$
				$[Ag+4ch]$
156	HORN QUICKSILVER	1.0..2.0	6.4..6.5	$Hg+\overset{\cdot\cdot}{m}$
				$[Me+2ch]$
150	HORN LEAD?	..3.0	6.0	$\overset{\cdot\cdot}{Pb},\ \overset{\cdot\cdot}{m},\ \overset{\cdot\cdot}{c}$

this Order, are for various reasons doubtful.

M. III. 135	*Pharmacolite.* Placed among the *Blooms* by Breith.
110	*Humboldtine.* Placed among Resins by Breith.
101	FLUELLITE. Wollaston.
147	ROSELITE. Levy.
136	*Phosphate of Manganese* ($\overset{\cdot\cdot}{Mn} + 2\overset{\cdot\cdot\cdot\cdot\cdot}{p}$) which in its composition resembles some of the above species, is placed by Mohs in the order OXIDE.

to their composition, in the circumstance of all of them containing muriatic acid combined with a metal.

The *name* HORN, prefixed to the name of the metal, falls in with the usual designation of them.

Mohs Bdt 453	Muriate of Silver. Horn Silver, P. 295.
Mohs Bdt 452	Muriate of Mercury, P. 359. *Quecksilber Hornerz.* Germ.
Mohs	*Murio-Carbonate of Lead. Corneous-Lead.* Jam.
M. II. 151	*Peritomous Lead Baryte?*

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ORDER IV. GREEN, OR BLUE.

THIS ORDER has considerable peculiarities, though it may not be easy to trace the exact distinction between it and adjacent orders. It consists of minerals of a non-metallic aspect, of very deep and vivid colours, generally green or blue, sometimes brown. The streak also is coloured. The hardness is in most cases between 3 and 4, and the specific gravity between 3.0 and 4.5. The chemical constitution of most of the species consists of a metallic oxyde ($\overset{\cdot\cdot}{Cu}$ or $\overset{\cdot\cdot}{Fe}$) combined with Arsenic or Phosphoric acid and with water. Copper however seems to assume the character of this order when not combined with these acids, but containing instead $\overset{\cdot\cdot}{c}$ or $\overset{\cdot\cdot\cdot}{S}$; and lead seems not to assume this character though combined with $\overset{\cdot\cdot}{\overset{\cdot\cdot\cdot}{As}}$ or $\overset{\cdot\cdot}{\overset{\cdot\cdot\cdot}{p}}$; such combinations being placed in Order II, as has been seen, where by their vivid colours and general appearance they seem to make the transition from that order to this. It is to be observed however that those species contain no water, and thus differ from those of this order. The difference between this and the succeeding order of *Blooms* is still more indistinct; and their chemical composition seems to be almost entirely analogous. It may therefore hereafter be found advisable to unite these orders into one.

The NAME given by Mohs to this order is *Malachite*, which has been usually applied to a prominent member of it. This name however would not, I think, be naturally adopted for many of the species: and in this case I have not been able to find any single word which has been commonly used which could easily be applied to all the species. Some of them however have from their colour had the substantive *green* employed to designate them; and the adjectives *blue* and *green* have been familiarly applied to most of them. It will therefore be a natural and easy way of designating this order to use BLUE or GREEN, according to the colour, for the substantive part of the name. The specific part of the name has, as in other cases, been selected with regard to the most simple and usual appellations.

ORDER IV. GREEN, OR BLUE.

		H	G	
M. III. 74	MURIATIC COPPER GREEN	3.0..3.5	4.43	$3\ddot{Cu}, \ddot{m}, q$ $[3\ddot{Cu}+$ $2Hch+6q]$
II. 167	AZURE COPPER BLUE	3.5..4.0	3.7..3.9	$3\ddot{Cu}+4\ddot{c}+2q$ $\ddot{Cu}+2\ddot{c}+$ $\frac{1}{2}(\ddot{Cu}+2q)$
175	MALACHITE GREEN	3.5..4.0	3.6..4.0	$\ddot{Cu}+\ddot{c}+q$
173	PSEUDO-MALACHITE GREEN	5.0	4.0..4.3	$5\ddot{Cu}+2\overset{\cdot\cdot}{\dddot{p}}+5q$
166	PHOSPHORIC OLIVE GREEN	4.0	3.6..3.8	$2\ddot{Cu}+\overset{\cdot\cdot}{\dddot{p}}+2q$
164	ARSENIC OLIVE GREEN	3.0..4.0	3.6..4.6	$\ddot{Cu}, \overset{\cdot\cdot}{\dddot{As}}$
III. 144	RADIATED OLIVE GREEN	2.5..3.0	4.2	$\ddot{Cu}, \overset{\cdot\cdot}{\dddot{As}}\ q$
II. 160	LENS BLUE	2.0..2.5	2.8..3.0	$\ddot{Cu}, \overset{\cdot\cdot}{\dddot{As}}\ q$
III. 149	SCOROD GREEN	3.5..4.0	3.162	$\ddot{Fe}+\overset{\cdot\cdot}{\dddot{As}}+xq$ $(+\ddot{Cu})$
162	CUBE GREEN	2.5	2.9..3.0	$5\dddot{Fe}+3\overset{\cdot\cdot}{\dddot{As}}+15q$ $5\ddot{Fe}$
158	CHRYSOCOLLA GREEN	2.0..3.0	2.0..2.2	$3\ddot{Cu}+2\dddot{s}+12q$
171	DIOPTASE GREEN	5.0	3.2..3.4	$\ddot{Cu}+\dddot{s}+2q$
III. 94	EUCHROSE GREEN	3.5..4.0	3.389	$\ddot{Cu}, \overset{\cdot\cdot}{\dddot{As}}, q$

	Muriate of Copper, P. 313. *Atakamite.*
Bdt 455	
Bdt 418	Blue Carbonate of Copper, P. 309. *Azurite.*
Bdt 417	Green Carbonate of Copper, P. 310. Malachite.
Berz. *Z.* 210	From Ehrenbreitstein. Hydrous Phosphate of Copper, P. 315. *Pseudomalachit.* Germ.
Berz. *Z.* 210	From Libethen. Phosphate of Copper, P. 319. *Olivenerz.* Germ.
Bdt 466	
Bdt 474	Right Prismatic Arseniate of Copper, P. 319. *Olivenerz.* Germ.
Berz. *N. S.* 101	
Bdt 474	Oblique Prismatic Arseniate of Copper, P. 318.
Berz. *N. S.* 101	*Radiated Acicular Olivenite.* Jam. It is sometimes blue.
Bdt 473	Octahedral Arseniate of Copper, P. 316. *Linsenerz.* Germ.
Bdt 475	Martial Arseniate of Copper, P. 320. Scorodite, P. 326. Breith. places this substance in the order Spar.
Berz. *Z.* 209	Arseniate of Iron, P. 241. *Cube Ore.* Jam.
Bdt 475	
Bdt 377	Chrysocolla, P. 312. *Copper Green.* Jam.
Bdt 376	Dioptase. Emerald Copper, P. 312.
	Euchroite. Haidinger.

ORDER IV. GREEN, OR BLUE.

The following Minerals perhaps belong to this Order.

		H	G	
M III. 81	BROCHANT GREEN?	3.5..4.0		$\overset{\cdot\cdot}{Cu}, \overset{\cdot\cdot\cdot}{s}$ (+&c.)
167	VAUQUELIN GREEN?	2.5..3.0	5.5..5.78	$\left.\begin{array}{l} 3\overset{\cdot\cdot\cdot}{Pb}+2\overset{:::}{cr}+ \\ 3\overset{\cdot\cdot}{Cu}+2\overset{:::}{cr} \end{array}\right\}$ $\overset{\cdot\cdot}{Fe}, \overset{\cdot\cdot}{Cu}$, &c.

Brochantite. Levy.

Vauquelinite. Chromate of Lead and Copper, P. 350.

Bdt 497

Breith. 185 *Chalcosiderite.* Ullman.
Velvet Blue Copper, M. III. 168.

ORDER V. BLOOM.

THIS ORDER is principally distinguished from the preceding by the foliated and easily cleavable nature of the minerals which it contains. In vividness of colour and other appearances it much resembles Order IV; the substances of this are however generally of smaller specific gravity. In chemical composition also it resembles the greater part of that Order; all its species consisting of a metallic oxyde ($\ddot{Cu}$, $\ddot{Fe}$, $\ddot{Co}$, $\ddot{Ni}$, $\dddot{Ur}$) combined with Phosphoric or Arsenic acid, and with water.

The NAME of this Order in Mohs is *Mica*, and he has included among the species the mineral usually so denominated; but the chemical ingredients of that substance make it highly improbable that there should be any analogy between it and the metallic Blooms; and even the external characters seem sufficiently distinct to separate it from them. The word BLOOM has been commonly applied to some of the species (Cobalt bloom, Nickel bloom) and seems to be exceedingly appropriate and easy of adoption in the other cases.

ORDER V. BLOOM.

		H	G	
M. II. 178	COPPER BLOOM	2.0	2.5..2.8	$\overset{\cdot\cdot}{Cu}, \overset{\cdot\cdot\cdot\cdot\cdot}{As}, q$
182	URAN BLOOM	2.0..2.5	3.0..3.2	$2\overset{\cdot\cdot\cdot}{U}+\overset{\cdot\cdot\cdot\cdot\cdot}{p}+12q$
184	COBALT BLOOM	2.5	2.9..3.1	$3\overset{\cdot\cdot}{Co}+2\overset{\cdot\cdot\cdot\cdot\cdot}{As}+12q$
188	IRON BLOOM	2.0	2.6..2.7	$2\overset{\cdot\cdot}{Fe}+p+12q$
	from Cornwall			$4\overset{\cdot\cdot}{Fe}+3\overset{\cdot\cdot\cdot\cdot\cdot}{p}+16q$
	from Bodenmais			$3\overset{\cdot\cdot}{Fe}+2\overset{\cdot\cdot\cdot\cdot\cdot}{p}+12q$
448	NICKEL BLOOM			$2\overset{\cdot\cdot\cdot}{Ni}+\overset{\cdot\cdot\cdot}{As}+18q$
	from Allemont			$3\overset{\cdot\cdot}{Ni}+2\overset{\cdot\cdot\cdot\cdot\cdot}{As}+18q$
III. 135	PHARMACON BLOOM?	very soft	2.64	$\overset{\cdot\cdot}{C}+\overset{\cdot\cdot\cdot\cdot\cdot}{As}+6q$ $5\overset{\cdot\cdot}{C}+4\overset{\cdot\cdot\cdot\cdot\cdot}{As}+30q$ $\overset{\cdot\cdot}{M}$

MICA?

Bdt 447	Rhomboidal Arseniate of Copper, P. 317.
Bdt 467	Uranite. Phosphate of Uranium, P. 267.
Berz. Z. 211	*Chalcolith.* $4\dddot{U}+\overset{\cdot\cdot}{\dddot{p}}+12q+\frac{1}{4}(3\ddot{Cu}+2\overset{\cdot\cdot}{\dddot{p}})$.
Bdt 472	Red Cobalt. Cobalt Bloom. Arseniate of Cobalt, P. 281.
Bdt 466	Phosphate of Iron, Vivianite, P. 238.
Berz. Z. 210	

Berz. Z. 210	Arseniate of Nickel. Nickel Ochre, P. 284. *Nickelblüthe.* Germ.

M. II. 180	*Kupferschaum.* $\ddot{Zi}$, $\ddot{Cu}$, q.
Bdt 472	Pharmacolite. Arseniate of Lime, P. 178.
Berz. Z. 209	*Picropharmacolite.*

Both Mohs and Breith. place Mica in this order, which does not seem to agree well either with the physical resemblances or the analogies of composition.

ORDER VI. LITE.

THIS ORDER is very clearly separated from the preceding ones, though it may not be equally evident that it is *one* order only. More accurate knowledge of the minerals contained in it may justify us in subdividing it. It answers to the order *Spathe* of Mohs; and to *Zeolith* and *Grammite* of Breithaupt. It includes nearly all the *Silicates* of Beudant, and this and the next order take in most of the "*Dry metal-oxides and their combinations*" of Leonhard. Its members have, it will be seen, this as their general chemical character;—that they consist entirely of earths (including $\ddot{Fe}$, $\ddot{Mn}$, $\dddot{Fe}$, &c.) and of alkalis. They seldom contain an acid, and according to the views of Berzelius, $\dddot{S}$ (sometimes $\dddot{A}$) must be considered as discharging the functions of an acid in their composition.

There are several well characterized groups or *Families* in this order. And these are distinguished both by their external resemblances, and by the similarity of their chemical formulæ. One of the most obvious is that of the *Zeolites*, which is by Breithaupt made a distinct Order. The minerals of this family are noticeable for their small specific gravity, (whence they are named by Mohs *Kouphone-Spars*;) and all contain a large proportion of water, (whence Breithaupt proposes the term *Hydrite* for them. The name *Zeolite* implies their frothing and swelling before the blow-pipe; a property which is common to nearly all of them. Several Species of this Family also gelatinize in acids.

Another Family consisting of several species closely related is formed by the minerals connected with those formerly called *Feldspar*. Besides the various subdivisions which have lately been established of the minerals formerly confounded under this name (Orthoclasite, Albite, Labradorite, &c.) it seems probable that several other species have a near relation to these. Leucite, Sodalite, Hauylite, (associated as one species by Breithaupt) are referred here both by their external characters and their chemical constitution. Petalite is made a species of the same genus by Breithaupt, Scapolite by Mohs. And from the chemical formulæ for Spodumenite, Prehnite, Gehlenite, &c. they may very probably find a place here.

A third Family which offers itself, is that including the substances anciently called *Schorl*, or *Hornblende*, including *Pyroxene*, *Hornblende*, *Epidote* of former mineralogists. The chemical formulæ corresponding to the different groups of this family have been recently investigated by different writers, and exhibit a remarkable correspondence.

The substances called *Diallage* by Haüy appear to be so closely connected with the preceding as to belong to the same Family, the chemical analysis also supporting this view.

Besides these, a few other minerals are placed in this order by Mohs, some of which may perhaps be considered as doubtfully established here. Mica, a mineral certainly not yet accurately determined and analysed, seems to have closer analogies with some of the species of this order, than with any other part of the system, and is placed here provisionally.

With respect to the Names here adopted, it may be observed, that it is to this order, more perhaps than to any other; that new minerals have been added by modern discoveries. The persons who have given names to these new minerals have in most instances coined for the purpose words ending in *lite* or *ite*, from an analogy with names previously current in which that Greek termination was found. As it would be extremely inconvenient to alter any large number of these names, the simplest plan seems to be to reduce *all* of them to this form, and to consider the termination *lite* or *ite* as indicating that a mineral belongs to this order, in the same way as calling it Gypsum-*Salt* or Calc-*Spar* indicates it to be a Salt or a Spar. To *confine* this termination to the present order will answer all the purposes of systematical language, apparently without incurring any great inconvenience by prohibiting it in other cases.

This rule being established, the syllable LITE separated from the remainder of the words, seems to be the most obvious name for the order itself, and to be also a word easily naturalized, as the English form of the Greek λιθος. It is the only word which I have ventured to invent, and its occurence in composition is so general in mineralogical names, that it may almost be considered as already existing in our language.

I have not endeavoured to systematize the names of families, (Feldspar, Hornblende, Diallage) for these subdivisions may be considered as either temporary only or as independent. If the present order remains entire they are not essential to the system; and if it be divided into other orders according to these families, the names now mentioned become names of orders and are not subject to the rules of subordination.

The most general received of the names of species, which for the sake of uniformity have been rejected, are those before mentioned, *Hornblende*, *Epidote*, and a few others, as *Mesotype*, *Analcime*, *Diopside*, *Hypersthene*. The names substituted for these, *Pargasite*, *Pistacite*, *Mesolite*, *Cubicite*, *Sahlite*, *Paulite*, are however almost equally well known. *Harmotome*, *Spodumene*, *Orthoclas*, are conformed to the rule by altering their terminations. Schiller-*Spar* is a term which cannot be retained, if our nomenclature is to have any meaning, and is rectified in the same manner. *Periklin* and *Tetartin* in the Feldspar family are modified in the same manner, it being assumed that the species are clearly established. In the other cases the names are all common ones, and generally the most common.

ORDER VI. LITE.

ZEOLITE FAMILY.

		H	G	
M. ii.236	MESOLITE	5.0..5.5	2.2..2.3	$2(\dddot{A}+\dddot{S})+\ddot{N}+2\dddot{S}+4q$
	SCOLEZITE			$2(\dddot{A}+\dddot{S})+\ddot{C}+2\dddot{S}+6q$
	NATROLITE			$2(\dddot{A}+\dddot{S})+3\ddot{N}+2\dddot{S}+4q$
iii. 162	THOMSONITE	5.0	2.37	$6(\dddot{A}+\dddot{S})+3\ddot{C}+2\dddot{S}+15q$
116	CARPHOLITE		2.935	$4(\dddot{A}+\dddot{S})+3\ddot{Mn}+2\dddot{S}+12q$
ii. 227	CUBICITE	5.5	2.2	$6(\dddot{A}+2\dddot{S})+3\ddot{N}+4\dddot{S}+18q$
229	HARMOTOMITE	4.5	2.3..2.4	$8(\dddot{A}+2\dddot{S})+3\ddot{B}+8\dddot{S}+42q$
232	CHABASITE	4.0..4.5	2.0..2.1	$2(\dddot{A}+2\dddot{S})+\ddot{C}+2\dddot{S}+12q$
234	LAUMONITE		2.3..2.4	$8(\dddot{A}+2\dddot{S})+3\ddot{C}+4\dddot{S}+36q$
239	STILBITE	3.5..4.0	2.0..2.2	$2(\dddot{A}+3\dddot{S})+\ddot{C}+2\dddot{S}+12q$
242	HEULANDITE	3.5..4.0	2.0..2.2	$8(\dddot{A}+3\dddot{S})+3\ddot{C}+6\dddot{S}+48q$?
iii. 30	BREWSTERITE	5.0..5.5	2.1..2.2	$8(\dddot{A}+3\dddot{S})+3\underset{\ddot{N}}{\ddot{C}}+6\dddot{S}+56q$?
ii. 244	APOPHYLLITE	4.5..5.0	2.2..2.5	$8(\ddot{C}+2\dddot{S})+\ddot{N}+4\dddot{S}+32q$
		3.5	2.376	$3(\dddot{A}+2\dddot{S})+\underset{\ddot{N}}{\ddot{C}}+4\dddot{S}+32q$?
				$3(\dddot{A}+3\dddot{S})+\ddot{C}+3\dddot{S}+56q$?
		4.0		
iii. 169	WAVELLITE?	3.5..4.0	2.337	$4(\dddot{A}+3\overset{\cdot\cdot}{\dddot{p}})+12q$
89	COMPTONITE?	5.0..5.0		

$\left.\begin{array}{l}\textit{Leucite}\\ \textit{Sodalite}\end{array}\right\}$ placed here by Mohs, seems to belong rather to the Feldspar Family.

Bdt 350	Mesotype, P. 123. Mesolite, P. 125.
Bdt 349	Skolezite, P. 40.
Mohs	Natrolite, P. 124. (Mesolite) Bdt says it is a mixture of the two preceding species.
Bdt 347	Thomsonite, P. 39. Berz. has $\ddot{N}$ with $\ddot{C}$.
Bdt 342	Carpholite, P. 22.
Bdt 348	Analcime, P. 227. *Cubizit.* Germ.
Bdt 356	Harmotome, P. 56.
Bdt 351	Chabasie, P. 138. Berz. Z. 200, has $\ddot{N}$ and $\ddot{K}$ as isomorphous with $\ddot{C}$.
Bdt 356	Laumonite, P. 45.
Bdt 352	Stilbite, P. 37. *Euzeolite,* Breith. 221. Berz. has $\ddot{N}$ with $\ddot{C}$.
Berz. Z. 200	Heulandite, P. 38. *Desmin.* Breith. 221.
Berz. Z. 200	Brewsterite, P. 200.
Bdt 390	Apophyllite. P. 244.
	Albin. Tesselite. Mesolype epointée. A variety of Apophyllite?
Berz. Z. 200	*Mesole.* M. III. 126.
	Mesoline. Breith. 222. M. III. 126. $\ddot{N}$ occurs with $\ddot{C}$.
	Levyne. same as Chabasite, Berz. M. III. 120.
Bdt 464	Wavellite. Sulphosphate of Alumine, P. 146. Klaprothite? Childrenite? Mohs places this among the Spars.
	Comptonite, P. 201.

ORDER VI. LITE.

FELDSPAR FAMILY.

PRISMATIC FELDSPAR GROUP. Form Oblique Prismatic.

Formula $2\,(\dddot{A}+3\,\dddot{S})+\ddot{R}+2\,\dddot{S}$ where $\ddot{R}$ is an alkali or earth.

		H	G	
M. II. 248	PETALITE	6.0..6.5	2.42..2.45	$2\,(\dddot{A}+3\,\dddot{S})+\ddot{L}+2\,\dddot{S}$
	PERIKLINITE	6.0..6.5	2.53..2.56	$2\,(\dddot{A}+3\,\dddot{S})+\ddot{K}+2\,\dddot{S}$? $\ddot{N}$
251	ORTHOCLASITE	6.0	2.48..2.58	$2\,(\dddot{A}+3\,\dddot{S})+\ddot{K}+2\,\dddot{S}$
255	ALBITE	6.0..6.5	2.5..2.6	$2\,(\dddot{A}+3\,\dddot{S})+\ddot{N}+2\,\dddot{S}$
257	LABRADORITE	6.0	2.6..2.7	$2\,(\dddot{A}+3\,\dddot{S})+\ddot{C}+2\,\dddot{S}$
	ANORTHITE	6.0	2.6..2.7	$\dddot{A}+\dddot{S}+\ddot{C}+3\,\dddot{S}$? $\ddot{M}$

DODECAHEDRAL GROUP.

224	LEUCITE	5.5..6.0	2.4..2.5	$6\,(\dddot{A}+2\,\dddot{S})+3\,\ddot{K}+4\,\dddot{S}$
225	SODALITE	5.5..6.0	2.2..2.4	$6\,(\dddot{A}+\dddot{S})+3\,\ddot{N}+2\,\dddot{S}$ $4\,(\dddot{A}+\dddot{S})+3\,\ddot{N}+4\,\dddot{S}$
III. 107	HAUYLITE	5.5..6.0	2.3..2.4	$2\,(\dddot{A}+\dddot{S})+\ddot{N}+2\,\dddot{S}$?
156				$6\,(\dddot{A}+\dddot{S})+3\,\ddot{M}2+\dddot{S}$
II. 288				$6\,(\dddot{A}+\dddot{S})+3\,\ddot{N}+2\,\dddot{S}$

Dihedral Angles of the Prisms of Cleavage, *A, B, C,* (Breith.)

This Group contains the minerals formerly called Feldspar or Felspar, as subdivided by G. Rose, *Ann. de Chimie,* T. 24, and by Breith. p. 66, 271.

		A	*B*	*C*
Breith. 272	Petalite, P. 142. Bdt. 355. has $4\dddot{S}$ for $2\dddot{S}$ in the formula.	141°30′	101°15′	117°15′
Breith. 274	*Periklin,* Breith. 66.	120 18	94 54	114 17
Breith. 275	Common Feldspar, P. 114. *Orthoklas.* Breith. 67. *Feldspath de Potasse.* Bdt. 353.	112 18	90 6	119 22
Breith. 277	Cleavelandite, P. 377. *Tetartin.* Breith. *Feldspath de Soude.* Bdt 353.	115 5	93 36	117 53
Bdt 354	Labrador Feldspar, *P.* 115. *Indianite. Feldspath de Chaux.* Bdt. 354.		94 30	
Breith. 278	*Anorthite.* G. Rose.	110 57	94 12	117 23

Bdt 348	Leucite, P. 107. *Amphigene.* Breith. makes Leucite and Sodalite the same species, and proposes to call it *Alkalite.*
Bdt 347 Berz. Z.201	Sodalite, P. 127. Bdt says it contains also $\ddot{m}$.
Bdt 346	Hauyne, P. 111.
Bdt 367	Spinellane, P. 127. *Nosin.* Breith. says this is dodecahedral and that *Spinellane, Hauyne, Lapis Lazuli* are the same species as *Leucite.*
Bdt 346	Lapis Lazuli, P. 44.

ORDER VI. LITE.

		H	G	
M.II.250	Sommite	6.0	2.5..2.6	$6(\dddot{A}+\dddot{S})+3\ddot{N}+2\dddot{S}$
290, 292	Lazulite	5.0..5.5	3.0..3.1	$\dddot{A}, \overset{\cdot\cdot}{\dddot{p}}, \ddot{M},$
264	Scapolite	5.0..5.5	2.5..2.8	$6(\dddot{A}+\dddot{S})+3\ddot{C}+2\dddot{S}$
III.70	Amblygonite	6.0	3.0..3.04	$\dddot{A}, \overset{\cdot\cdot}{\dddot{p}}, \ddot{L}, \ddot{f}$
II. 216	Spodumenite	6.5..7.0	3.0..3.1	$2(\dddot{A}+2\dddot{S})+\ddot{+}L2\dddot{S}$
217	Prehnite	6.0..6.7	2.8..3.0	$4(\dddot{A}+\dddot{S})+3\ddot{C}+4\dddot{S}$

The following Minerals are placed by Breithaupt

M.III.84	Chiastolite	5.0..5.5	2.944	$\dddot{A}, \dddot{S}$
131	Nephrite	7.0	2.932..3.03	$\dddot{A}, \dddot{S}, \ddot{M}$
83	Calaite	6.0	2.83..3.0	$\dddot{A}, \overset{\cdot\cdot}{\dddot{p}}, \ddot{C}, C\ddot{u}$
96	Eudialite	5.0..5.5	2.898	$\dddot{S}, \ddot{Z}, \ddot{C}, \ddot{N}$
102	Gehlenite	5.5..6.0	3.029	$2\dddot{A}+\dddot{S}+3\ddot{C}+2\dddot{S}$?

HORNBLENDE FAMILY.

(1) EPIDOTE GROUP. Formula $3\dddot{R}+4\dddot{S}+4(\dddot{A}+S)$

M.II.282	Pistacite	6.0..7.0	3.2..3.5	$3\ddot{C}+4\dddot{S}+4(\dddot{A}+\dddot{S})+$ $3\ddot{Fe}+4\dddot{S}+4(\dddot{A}+\dddot{S})$
284	Zoisite	——	——	$3\ddot{C}+4\dddot{S}+4(\dddot{A}+\dddot{S})$

Feldspar Family.

Berz. Z. 201	Sommite, P. 125. *Nepheline.* Bdt 374 *Elæolith.* M. III. 93.
Mohs	Lazulite. Azurite, P. 94. Blue Feldspar, P. 115. Breith. says these are one species, p. 218.
Bdt 344	Scapolite. Meionite, P. 264. *Wernerite. Paranthine. Dipyre. Tetraklasit.*
Breith. 218	Amblygonite, P. 198.
Bdt 351	Spodumene, P. 142, *Triphane.*
Bdt 342	Prehnite, P. 36.

in this part of the System. Breith. 61, 62, 63.

Bdt 363	Chiastolite, P. 201. *Andalusite.* Bdt ?
Bdt 366	Nephrite, P. 134.
Bdt 465	Calaite, P. 79. *Turquoise.*
Bdt 391	Eudyalite, P. 122.
Bdt 367	Gehlenite, P. 35. *Stylobat.*

where R may be C or Fe.

Bdt 343	Epidote, P. 41. *Pistazit.* Germ. *Thallite. Epidote Calcareo-ferrugineux.*
Bdt 343	Zoisite, P. 41. *Epidote Calcaire.*

ORDER VI. LITE.

(2) PYROXENE GROUP. Formula $3\dddot{R}+4\dddot{S}$, where R may

		H	G	
M. 272	SAHLITE	5.0..6.0	3.2..3.5	$3\ddot{C}+4\dddot{S}+3\ddot{M}+4\dddot{S}$
	HEDENBERGITE	—	—	$3\ddot{C}+4\dddot{S}+3\ddot{Fe}+4\dddot{S}$
	PYROSMALITE?	—	—	$3\ddot{Mn}+4\dddot{S}+3\ddot{Fe}+4\dddot{S}$
268	AUGITE	—	—	mixture of two last
286	WOLLASTONITE	4.5..5.0	2.7..2.9	$3\ddot{C}+4\dddot{S}$

(3) AMPHIBOLE GROUP. Formula $3\ddot{R}+4\dddot{S}+\ddot{Q}+2\dddot{S}$,

M. 274	TREMOLITE	5.0..6.0	2.8..3.2	$3\ddot{M}+4\dddot{S}+\ddot{C}+2\dddot{S}$
	ACTINOLITE	—	—	$3\ddot{Fe}+4\dddot{S}+\ddot{C}+2\dddot{S}$
	PARGASITE	—	—	$3\ddot{Fe}+4\dddot{S}+\ddot{C}+2\dddot{S}$ $\dddot{A}$
III. 67	ACMITE	6.0..6.5	3.24	$2(\dddot{Fe}+2\dddot{S})+\ddot{N}+2\dddot{S}$
115	JEFFERSONITE	4.5	3.51..3.60	$\ddot{C}+2\dddot{S}$, $\ddot{Mn}+2\dddot{S}$, $\ddot{Fe}+2\dddot{S}$

HORNBLENDE FAMILY.

be *C*, *M*, *Fe*, or *Mn*. H. Rose. *Ann. of Phil.* Vol. XXI. p. 223.

Bdt 384	Sahlite. Diopside, P. 60, 61. *Pyroxene Calcareo-Magnesien.* Bdt.
Bdt 384	Hedenbergite, P. 66. *Pyr. Calc. Ferrugineux.* Bdt. P. makes it agree with Amphibole.
Bdt 385	*Pyrosmalite. Pyr. Ferro-Manganesien.* Bdt. Breith. says *Pyrosmalite* is identical with *Margarite*, p. 183.
Bdt 385	Augite. Pyroxene, P. 58.
Bdt 377	Tabular Spar. P. 23. Wollastonite, P. 211. Mohs places it here, but Breith. among the Spars.
	Coccolite, Strahlstein, Baikalite, Fassaite, Omphazite, are also varieties of this group. M. II. 272. P. 60, 62, 68, 209.

where *R* may be *M* or *Fe*, and *Q* may be *C* or *Mn*, also *S* may be in part replaced by *A*. Bonsdorf, *Ann. de Chim.* Tom. XX. p. 31.

Bdt 387	Tremolite, P. 66. *Amphibole Calcareo-Magnesien.* Bdt.
Bdt 387	Actynolite, P. 68. *Amph. Calc. Ferrugineux.* Bdt.
Bdt 388	Hornblende, P. 63. Pargasite, P. 65. *Amphibole Hornblende.* Bdt.
Bdt 352	*Achmite.* Strom.
Breith. 280	Jeffersonite, P. 24.
Bdt 309	*Yenite*, from its formula $3\ddot{C}+2\dddot{S}+4(3\ddot{Fe}+2\dddot{S})$, might seem rather to belong to this place than to the Order of Oxides where it is arranged.

ORDER VI. LITE.

(4) **DIALLAGE GROUP.** Formula $3\ddot{R}+4\dddot{S}$, where R may

		H	G	
M.II.206	SCHILLERITE	3.5..4.0	2.6..2.8	$\left.3\begin{matrix}\ddot{Fe}\\ \ddot{M}\end{matrix}+4\begin{matrix}\dddot{S}\\ \dddot{A}\end{matrix}\right\}$
207	BRONZITE	4.0..5.0	3.0..3.3	$\left.3\begin{matrix}\ddot{M}\\ \ddot{Fe}\end{matrix}+4\dddot{S}\right\}$
210	PAULITE	6.0	3.3..3.4	$\left.\begin{matrix}3\ddot{Fe}+4\dddot{S}+\\ 3\ddot{M}+4\dddot{S}\end{matrix}\right\}$
211	ANTHOPHYLLITE	5.0..5.5	3.0..3.3	$\ddot{Fe}$, $\dddot{S}$, $\dddot{A}$, &c.

M.II.213	CYANITE?	5.0..7.0	3.5..3.7	$2\dddot{A}+\dddot{S}$
	Pinite?			$2\dddot{A}+\dddot{S}$
	Pinite?			$\dddot{A}+2\dddot{S}$
131	Chlorite?	1.0..1.5	2.7..2.8	$\ddot{M}+2\dddot{S}$
198	Mica (Mica-lite?)	2.0..2.5	2.8..3.0	$\left.8\left(\begin{matrix}\dddot{A}\\ \dddot{Fe}\end{matrix}+\dddot{S}\right)+\ddot{K}+2\dddot{S}\right\}$
204	Margarite?	3.5..4.5	3.032	$\dddot{S}$, $\dddot{A}$, $\ddot{K}$, $\ddot{Fe}$
220	*DATOLITE?*	5.0..5.5	3.0	$\ddot{C}+2\dddot{S}+\ddot{C}+4\ddot{b}+2q$

be M, Fe, C: and S may be partly replaced by A. Bdt. 382.

Bdt 382	Schiller Spar, P. 71.
Bdt 380	Bronzite, P. 25. Breith. 204.
Bdt 383	Hypersthene, P. 70. *Paulit.* Wern.
Bdt 368	Anthophyllite, P. 69. *Omphazit*? *Diaklas*? Breith. p. 202. *Diallage Verte*?

Bdt 333	Cyanite, P. 81. *Disthene.* *Rhætizite.* Fibrolite, P. 80? Perhaps belonging to the next order.
Bdt 332	From Saxony. Pinite, P. 80. Gieseckite, P. 113?
Bdt 332	From Auvergne.
Bdt 379	Talc. Green Earth. Chlorite, P. 116, 117, 120.
Bdt 362	Mica, P. 106. Probably several species exist, hereafter to be distinguished.
Bdt 365	Margarite, P. 208.
Bdt 395	Datolith. Borate of Lime, P. 177. M. places this among the Lites, but Breith. among the Spars.

ORDER VII. GEM.

A CONSIDERABLE portion of the ORDER *Gem* has a very distinct and peculiar character. It consists of stones eminent for their hardness, brilliance and colour, and which have therefore always been valued as objects of ornament and merchandize, as the Diamond, Sapphire, Chrysoberyl, Opal, &c. It is very remarkable also that these stones possess a great simplicity of chemical constitution; consisting either of a single element or earth, as Diamond, Sapphire, Crystal, (Quartz); or of a very simple combination of two earths, as in Cymophane, Zircon, Peridot, &c.

What is here said however does not apply strictly to the whole of the order, and it may be conjectured that the boundary between this and the preceding order is not yet finally settled. The earlier species of the following list, (Garnet, Tourmaline, Axine) seem to have considerable resemblances with some of the Lites. The Garnets in particular seem closely connected by their chemical composition, as well as by their character, mode of occurrence, &c. with the Hornblende Family. The Tourmaline and Axine species have also some relations with the same family, and indeed the common name Schorl was formerly applied to both of them. Emerald, and Euclase seem in their composition to resemble Tourmaline. While Tourmaline and Axine, containing a portion of acid (Boracic) are in this respect similar to Topaz, of which Fluoric acid is a constituent. The minerals which succeed these in the list exhibit more distinctly the character of the order, as composed of earths; though in some of the species connected with these, as Peliom, Opal, the exact formula has perhaps not yet been obtained.

In this order it has not been thought necessary to use the NAME of the order, *Gem*, as an element of the specific name. In consequence of the long and familiar prevalence which many of these names can boast, such an appendage would be an interference with the common use of language, difficult to carry into effect, even if it were necessary. The absence of this part of the name however, in this one order, does not essentially diminish the completeness of the system of nomenclature.

As was noticed in speaking of the last order, the name, in this, ought not to terminate in *ite*; and here, when an usual name did not offer itself agreeable to this rule, the termination has been altered, generally so as to make *n* the last consonant. This form has been made to apply to all the cases which were mentioned as connecting this order with the preceding, viz. the species of Garnet, Tourmaline, and Axine. It is hoped that the new forms of words thus introduced, are neither many nor very repulsive.

Order VII. GEM.

Garnet Family.

Dodecahedral Garnet Group. Formula $2(\dddot{Q}+\dddot{S})+3\ddot{R}+2\dddot{S}$,

		H	*G*	
M.II.359	Alamandine	7.0..8.0	4.0..4.3	$2(\dddot{A}+\dddot{S})+3\ddot{Fe}+2\dddot{S}$
364	Grossuline	6.5..7.5	3.5..3.9	$2(\dddot{A}+\dddot{S})+3\ddot{C}+2\dddot{S}$
	Manganesine	—	—	$2(\dddot{A}+\dddot{S})+3\ddot{Mn}+2\dddot{S}$
	Melane	—	—	$2(\dddot{Fe}+\dddot{S})+3\ddot{C}+2\dddot{S}$

354	Vesuvian	6.5	3.3..3.4	$2(\dddot{Q}+\dddot{S})+3\ddot{R}+2\dddot{S}$ (as above)
366	Grenatine	7.0..7.5	3.3..3.9	$6(2\dddot{A}+\dddot{S})+3\ddot{Fe}+\dddot{S}$
357	Helvine	6.0..6.5	3.1..3.3	same as garnet?
373	Sphene?	5.0..5.5	3.4..3.6	$3(\dddot{Ti}+\ddot{C})+\ddot{C}+4\dddot{S}$

M. 341	Axine	6.5..7.0	3.0..3.3	$2(\dddot{A}+\dddot{S})+3\ddot{R}+4\dddot{S}\ (+\ddot{b})$
347	*Boracine?*	7.0	2.8..3.0	$\ddot{M}+4\ddot{b}$
349	Tourmaline	7.0..7.5	3.0..3.2	$6(\dddot{A}+\dddot{S})+\ddot{K}\ (+\ddot{b})$
	Rubelline	—	—	$6(\dddot{A}+\dddot{S})+\ddot{N}$
353	Indicone	—	—	$6(\dddot{A}+\dddot{S})+\ddot{L}$
293	Andalusine	7.5	3.0..3.2	$6(2\dddot{A}+\dddot{S})+\ddot{K}+2\dddot{S}$

where Q is A or Fe, and R is C, M, Fe, Mn.

Bdt 337	Alamandine, P. 26. *Grenat de Fer. Pyrope, Grenat syrien, oriental, Escarboucle.* Bdt.
Bdt 338	Grossular, P. 28. *Grenat de Chaux. Aplome, Topazolite, Succinite, Allochroite, Essonite.* Bdt.
Bdt 338	Manganesian Garnet, P. 29. *Grenat de Manganese. Rhotofite, Romanzowite, Pechgranat, Colophonite.* Bdt.
Bdt 338	Melanite, P. 30. *Grenat Melanite. Pyreneite.*
	Most of the Garnets which occur are mixtures of these formulæ.

Bdt 339	Idocrase, P. 33. *Vesuvian* Germ.
Bdt 357	Straurolite, Grenatite, P. 82.
Bdt 339	Helvine, P. 244.
Bdt 494	Sphene, P. 262. Breith. joins this with Helvine.
	Anatase ($\ddot{Ti}$ or $\dddot{Ti}$) is placed here by Breith. He had united Anatase, Axine, Boracine, Tourmaline in one genus, and from their characters had asserted that they must all contain Boracic acid, which has since been verified in Axine and Tourmaline. Br. 229.

Bdt 359	Axinite, P. 43. R is mixed of C, M, Fe. *Sordawalite?*
Bdt 395	Boracite. Borate of Magnesia, P. 181.
Bdt 359	Tourmaline, P. 139. *Tourmaline de Potasse, Magnesie, &c. Schorl.* Bdt. $\ddot{M}$ occurs along with $\ddot{K}$.
Bdt 359	Rubellite, P. 126. *Tourmaline de Soude.* Bdt.
Bdt 359	Indicolite, P. 139. *Tourmaline de Lithine.* Bdt.
Bdt 363	Andalusite, P. 108.

ORDER VII. GEM.

		H	*G*	
M. 316	EMERALD	7.5..8.0	2.6..2.8	$2(\dddot{A}+2\dddot{S})+\dddot{G}+4\dddot{S}$
313	EUCLASE	7.5	2.9..3.2	$2(\dddot{A}+\dddot{S})+\dddot{G}+\dddot{S}$
308	TOPAZ	8.0	3.0	$6(\dddot{A}+\dddot{S})+4\dddot{A}+3\ddot{f}$
295	SPINELLE	8.0	3.5..3.8	$4\dddot{A}+\ddot{M}(\ddot{F}e,\overset{\substack{\cdots\\\cdots}}{Cr})$
298	AUTOMOLE	8.0	4.1..4.3	$4\dddot{A}+\overset{\cdot\cdot}{Zn}$
304	CYMOPHANE	8.5	3.65..3.8	$4\dddot{A}+\dddot{S}$
299	CORUNDUM	9.0	3.9..4.05	$\dddot{A}$
306	DIAMOND	10.0	3.4..3.6	c
II. 321	QUARTZ	7.0	2.5..2.7	$\dddot{S}$
319	PELIOM	7.0..7.5	2.5..2.6	$8(\dddot{S}+\dddot{A})+4\dddot{S}+3\ddot{M}$
332	OPAL	5.5..6.5	1.9..2.2	$2\dddot{S}+q$?
	OBSIDIAN	6.0..7.0	2.2..2.4	$\dddot{S}$, $\dddot{A}$, $\ddot{N}$, $\ddot{K}$, $\ddot{C}$
368	ZIRCON	7.5	4.5..4.7	$\ddot{Z}$, $\dddot{S}$
371	GADOLINE	6.5..7.0	4.0..4.3	$3\ddot{Y}+2\dddot{S}$
345	PERIDOT	6.5..7.0	3.3..3.5	$3\ddot{M}+2\dddot{S}$
346	OLIVINE	——	——	——
III. 87	CHONDRODINE	6.5	3.2	$3\ddot{M}+2\dddot{S}$

(GEMS PROPER?)

Bdt 335	Beryl. Aquamarine. Emerald, P. 102. 104.
Bdt 336	Euclase, P. 101.
Bdt 458	Topaz, P. 84.
Bdt 485	Spinelle Ruby, P. 90. Pleonaste, P. 92. *Zeilanite.*
Bdt 486	Automalite, P. 83. *Gahnite.*
Bdt 334	Chrysoberyl, P. 89. *Cymophane.*
Bdt 484	Corundum, P. 74. *Sapphire. Ruby. Adamantine Spar. Telesie.*
Bdt 396	Diamond, P. 361.
Bdt 328	Quartz, P. 1. Cat's-Eye. Flint. Chalcedony. Jasper. Hornstone. Chrysoprase. *Amethyst* is said both by Herschel and Brewster to be essentially different from common Quartz.
Bdt 357	Iolite. Dichroite, P. 93. *Peliom. Cordierite. Fahlunite. Triclasite.* Breith. 225.
Bdt 331	Opal, P. 12. Hyalite. Hydrophane. Menilite. Cacholong. Siliceous Sinter.
Bdt 354	Pearl-stone. Pitch-stone. Pumice. Obsidian, P. 112, &c.
	Lydian Stone, P. 47. Sphærolite, P. 209. are made separate species by Breith. 76. 221.
Bdt 373	Zircon, P. 99. *Hyacinth.* Zeagonite? P. 211.
Bdt 373	Gadolinite, P. 105.
Bdt 378	Chrysolite, P. 95. *Peridot.* The $\ddot{M}$ is mixed with $\overset{..}{Fe}$.
Bdt 379	Olivine, P. 96. same species? It has an excess of $\dddot{S}$.
Bdt 378	Condrodite. Brucite. Maclureite, P. 97.

ORDER VIII. OXIDE.

THE ORDER *Oxide* is on the whole well characterised, consisting for the most part of the Oxides of metals, with a great similarity of general appearance. The uniformity of composition is in several cases probably disturbed by mixtures of which the law is not yet known: and it may also be conjectured that the species which contain a considerable portion of earths ($\dddot{S}$ and $\ddot{C}$) will perhaps be found to have a place elsewhere. Different degrees of oxidation ($\ddot{Fe}$ and $\dddot{Fe}$, $\ddot{Mn}$ and $\dddot{Mn}$) seem to stand here together; and those minerals which contain water do not seem to be excluded.

The NAME *Oxide* is given to this order, on the supposition that it will be found to reduce itself to such combinations when more accurately examined. It agrees with Mohs's order *Ore*, but that word is in English generally used with a latitude of application extending much beyond this order, and it seemed therefore requisite to have a more definite term. The names of the species generally involve that of the metal which they contain.

ORDER VIII. OXIDE.

		H	G	
M. II. 373	Sphene ?	5.0..5.5	3.4..3.6	$3\,\ddddot{Ti}+\ddot{C}+$ $4\,\dddot{S}+\ddot{C}$
379	ANATASE TITANIUM OXIDE	5.5..6.0	3.8..3.9	$\ddot{Ti}$?
376	RUTILE TITANIUM OXIDE	6.0..6.5	4.2..4.4	$\ddddot{Ti}\,(+\dddot{Fe},$ $\ddot{Mn},\ \ddot{C})$
397	TITANITIC IRON OXIDE	5.0..5.5	4.4..4.8	$\ddot{Fe},\ \ddddot{Ti}$
399	OCTAHEDRAL IRON OXIDE	5.5..6.5	4.8..5.2	$\ddot{Fe}+2\,\dddot{Fe}$
403	DODECAHEDRAL IRON OXIDE	6.0..6.5	5.0..5.1	$\ddot{Fe},\ \ddot{Mn},\ \ddot{Zn}$
404	SPECULAR IRON OXIDE	5.5..6.5	4.8..5.3	$\ddot{Fe}+3\,\dddot{Fe}$
	Red Iron Oxide	6.0	4.7..4.9	———
III. 158	STILPNOUS IRON OXIDE	4.5	3.6	$2\,\ddot{Fe}+3q$
II. 414	ELBA IRON OXIDE ?	5.5..6.0	3.8..4.1	$12\,\ddot{Fe}+$ $10\,\dddot{S}+3\,\ddot{C}$
III. 91		2.5	3.348	$\ddot{Fe},\ \dddot{S},\ q$ $(+\ddot{Mn},\ \ddot{M})$
II. 396	CHROMIC IRON OXIDE	5.5	4.4..4.5	$\ddot{Fe},\ \dddot{Cr},\ (+\dddot{A})$
387	WOLFRAM IRON OXIDE	5.0..5.5	7.1..7.4	$\ddot{Mn}+2\,\dddot{W}$ $\ddot{Fe}$
416	BLACK MANGANESE OXIDE	5.0..5.5	4.7..4.3	$\ddot{Mn}+2\,\dddot{Mn}$?
418	HARD GREY MANGANESE OXIDE	5.0..6.0	4.0..4.1	$\ddddot{Mn}$
419	SOFT GREY MANGANESE OXIDE	2.5..3.5	4.4..4.8	$\ddot{Mn}+q$

Bdt 494	Sphene, P. 262. See the order Gem.
Bdt 493	Anatase, P. 257. *Octaedrite.*
Bdt 492	Titanite, P. 258. Nigrine, P. 259. Iserine. Menaccanite, P. 260?
Leonh. 725	Brookite. (Levy.) contains $\ddot{T}i$ and resembles Anatase and Rutile. M. III. 82.
Bdt 493	Crichtonite, P. 261. Mohs II. 399. Breith. p. 244.
Bdt 502	Oxydulated Iron, P. 221. *Ferrate de Fer.* Bdt.
Bdt 482	Franklinite, P. 226.
Bdt 501	Specular Iron, P. 224 } according to Breith. these are two different species, p. 244.
	Red Iron Ore, P. 224 }
Bdt 503	Stilpnosiderite, P. 227. *Hydroxide de Fer.* Bdt.
Bdt 389	Lievrite. Yenite, P. 24. *Ilvaïte.* Bdt. Perhaps a Lite of the Hornblende Family.
Bdt 391	Cronstedtite, P. 227. *Chloromelan.* Perhaps a Bloom. See Breith. 184.
Bdt 496	Chromate of Iron, P. 240.
Bdt 496	(Oxide of Chrome, P. 271. ($\dddot{C}r$).)
Bdt 490	Wolfram. Tungstate of Iron, P. 255.
	(Oxide of Tungsten, P. 254. ($\ddot{W}$)?)
Bdt 499	Black Manganese, P. 381. *Manganate de Manganese.* Bdt.
Bdt 498	Compact Grey Oxide of Manganese, P. 244. *Peroxide de Mang.*
Bdt 499	Grey Oxide of Manganese, P. 243. *Hydroxide de Mang.*

ORDER VIII. OXIDE.

		H	*G*	
III. 136	PHOSPHORIC MANGANESE OXIDE	5.0..5.5	3.4..3.8	$2\,\overset{\cdot\cdot}{Mn}+\overset{:\cdot:}{p}+$ $2\,\overset{\cdot\cdot}{Fe}+\overset{:\cdot:}{p}$
II. 380	RED ZINC OXIDE	4.0..4.5	5.4..5.5	$\overset{\cdot\cdot}{Zn}$
381	RED COPPER OXIDE	2.5..4.0	5.6..6.0	$\overset{\cdot}{Cu}$
	Black Copper Oxide			$\overset{\cdot\cdot}{Cu}$
384	TIN OXIDE	6.0..7.0	6.3..7.1	$\overset{\cdot\cdot\cdot\cdot}{Sn}$
390	TANTALUM OXIDE	6.0	6.0..6.3	$\overset{\cdot\cdot}{Mn}+\overset{\cdot\cdot}{Ta}+$ $\overset{\cdot\cdot}{Fe}+\overset{\cdot\cdot}{Ta}$
III. 173	YTTRO-TANTALUM OXIDE	4.0	5.4..5.9	$2\,\overset{\cdot\cdot}{Y}+\overset{\cdot\cdot}{Ta}$
II. 393	URANIUM OXIDE	5.5	6.4..6.6	$3\,\overset{\cdot\cdot}{Y}+\overset{\cdot\cdot\cdot}{Ta}$ $\overset{\cdot\cdot}{U}$
394	RED CERIUM OXIDE	5.5	4.9..5.0	$3\,\overset{\cdot\cdot}{Ce}+2\,\overset{\cdot\cdot\cdot}{S}+6q$
III. 68	BLACK CERIUM OXIDE	6.0	4.0	$3\,\overset{\cdot\cdot}{Ce}+2\,\overset{\cdot\cdot\cdot}{S}+$ $3\,\overset{\cdot\cdot}{Fe}+2\,\overset{\cdot\cdot\cdot}{S}$

Bdt 467	Phosphate of Manganese, P. 248. *Eisenpecherz. Triplite.*
Bdt 480	Red Oxide of Zinc, P. 353.
Bdt 505	Red Oxide of Copper. Oxydulated Copper, P. 306.
Bdt 505	Black Copper, P. 308. Kupferschwarz.
Bdt 480	Oxide of Tin, P. 250.
Bdt 489	Columbite, P. 269. *Tantalite.*
	From Bodenmais, $2\,\ddot{Mn}+\ddot{Ta}+3\,(2\,\ddot{Fe}+\ddot{Ta})$
Bdt 489	Yttro-Columbite, P. 281. *Fergusonite?* M. III. 93.
Bdt 497	Uran-Ochre. Pitch-blende, P. 393.
Bdt 374	Cerite, P. 263.
Bdt 390	Allanite, P. 264. Cerin.
	Orthite, P. 265. Yttrocerite, P. 265. Pyrorthite, P. 265.

ORDER IX. METAL.

THIS ORDER is very manifestly a natural one. All the minerals which are certainly members of it, consist of a simple metal with only trifling impurities, and are characterized by their metallic lustre, weight, streak, &c. The hardness of the species is variable, being however in general considerably less than that of the preceding order. One very remarkable property of the species of this order is their crystallization, which is, apparently in all, of the tessular system. Indeed in a substance perfectly simple, it would seem that this is the only crystalline form which can exist. Hence it is probable that those species which do not possess this character, as Native Antimony, Antimonial Silver, &c. are to be referred to another place.

The NAMES adopted in this order, are the usual names of the metals with the adjective *native* prefixed to them; which is also the usual designation of these species. Platina has been changed into Platinum, in order to make it analogous to the other names of metals, which are all neuter in Latin. (Ferrum, Cuprum, &c.)

ORDER IX. METAL.

		H	G	
M. II. 423	NATIVE ARSENIC	3.5	5.7..5.8	As (+ Sb, &c.)
424	NATIVE TELLURIUM	2.0..2.5	6.1..6.2	Sb
430	NATIVE BISMUTH	2.0..2.5	9.6..9.8	Bi
433	NATIVE SILVER	2.5..3.0	10.0..10.5	Aq (+ Sb, As, Fe, &c.)
436	NATIVE GOLD	2.5..3.0	12.0..20.0	Au (+ Ag, &c.)
441	NATIVE PLATINUM	4.0..4.5	16.0..20.0	Pt
442	NATIVE IRON	4.5	7.4..7.8	Fe (+ Ni, &c.)
444	NATIVE COPPER	2.5..3.0	8.4..8.9	Cu
426	NATIVE ANTIMONY	3.0..3.5	6.5..6.8	Sb
431	NATIVE AMALGAM	1.0..3.0	10.5..12.5	$Ag+2Hg$
432	NATIVE MERCURY	0.0	12.0..15.0	Hg
	NATIVE PALLADIUM		11.8..12.1	Pd
III. 114	IRIDIUM-OSMIUM		19.5	Ir, Os
II. 427	ARSENICAL SILVER	3.5	8.9..10	$Ag+2As$ (+ Fe, Sb)
429	ANTIMONIAL SILVER			$2Ag+Sb$

Bdt 468	Native Arsenic, P. 275.
Bdt 461	Native Tellurium, P. 326.
Bdt 481	Native Bismuth, P. 272.
Bdt 482	Native Silver, P. 285.
Bdt 506	Native Gold, P. 322.
Bdt 506	Native Platina, P. 324.
Bdt 500	Native Iron, P. 213.
Bdt 504	Native Copper, P. 296.
Bdt 477	Native Antimony, P. 329. The Rhombohedral form of this mineral seems to negative the supposition of its being a simple metal.
Bdt 482	Native Amalgam, P. 357.
Bdt 507	Native Palladium, 325.
Bdt 507	Alloy of Iridium and Osmium, P. 326. *Osmuire d'Iridium.* Bdt.
Bdt 468	Arsenical Antimonial Silver, P. 287. Prismatic?
Bdt 478	Antimonial Silver, P. 286. It is doubted whether these two species are distinct.

ORDER X. PYRITES.

THIS ORDER *Pyrites* and the two succeeding ones, *Glance* and *Blende,* are very clearly separated by their external characters, though it may not be so easy to determine exactly, what is the corresponding difference of chemical constitution. All the three orders seem to consist of a metal combined with sulphur, or with some other element, (arsenic, selenium, &c.) which discharges the same function as sulphur. The order now before us is remarkable for the eminent metallic appearance of the minerals composing it; which are crystalline and opake, and resemble generally a bright white or yellow metal. The hardness of the species is in most cases considerable, being greater than that of the Native metals. It can hardly be doubted that a more exact knowledge of the composition of the Pyrites, would lead us to some general formula including them all.

The resemblance of these species is so evident that the NAME *Pyrites* has very generally been given to most of them, and can easily be adopted for the others.

ORDER X. PYRITES.

		H	G	
M. II. 469	YELLOW COPPER PYRITES	3.5..4.0	4.1..4.3	$Cu+s$
467	PURPLE COPPER PYRITES	3.0	4.9..5.1	$\left.\begin{matrix} Cu+2s+ \\ Fe+2s \end{matrix}\right\}$
465	MAGNETIC IRON PYRITES	3.5..4.5	4.4..4.7	$Fe+2s$
461	WHITE IRON PYRITES	6.0..6.5	4.6..4.9	$Fe+4s$
457	YELLOW IRON PYRITES	6.0..6.5	4.9..5.0	$Fe+4s$
449	ARSENICAL IRON PYRITES	5.5..6.0	5.7..6.2	$\left.\begin{matrix} Fe+4s+ \\ Fe+2As \end{matrix}\right\}$
448	AXOTOMOUS ARSENICAL PYR.	5.0..5.5	7.1..7.4	$Fe,\ As$
452	TIN-WHITE COBALT PYRITES	5.5	6.1..6.6	$\left.\begin{matrix} Fe+As+ \\ Co+As \end{matrix}\right\}$
455	SILVER-WHITE COBALT PYRITES	5.5	6.1..6.4	$Co+2As$
456	GREY COBALT PYRITES	—	—	$\left.\begin{matrix} Co+2As+ \\ Co+4s \end{matrix}\right\}$ $Co,\ s,\ Fe,\ Cu$
446	ARSENICAL NICKEL PYRITES	5.0..5.5	7.5..7.7	$Ni+As$
III. 129	CAPILLARY NICKEL PYRITES	—	—	$Ni+2s$
131	NICKILIFEROUS ANTIMONY PYRITES	5.0..5.5	6.451	$Ni,\ As,\ Sb,\ s$
163	CUPRIFEROUS TIN *PYRITES?*	4.0	4.35	$\left.\begin{matrix} Sn+2s+ \\ Cu+2s \end{matrix}\right\}$
171	Yellow Tellurium (Pyrites?)	soft	10.7	$\left.\begin{matrix} Pb+Te \\ (+Au,\ Ag) \end{matrix}\right\}$

Bdt 426	Copper Pyrites. Yellow Copper Ore, P. 302.
Bdt 436	*Buntkupfererz.* Purple Copper, P. 299.
	Arsenical Copper Pyrites. White Copper, P. 304. *Weisskupfererz.*
Bdt 426	Magnetic Iron Pyrites, P. 221. Mixed with $Fe+4s$.
Bdt 425	White Iron Pyrites, P. 220. *Quadrisulfure prismatique.* Bdt. *Spärkies. Kamkies. Leberkies. Strahlkies.* Germ.
Bdt 425	Iron Pyrites, P. 221. *Quadrisulfure Cubique.* Bdt. It contains As.
Bdt 432	Arsenical Iron. Mispickel, P. 215. *Sulfo-arseniure de Fer.* Bdt.
	Glanzarsenik-kies? Breith. 248.
Bdt 470	Tin White Cobalt, P. 280. *Grey Cobalt Ore, and Radiated White Cobalt.* Jam. *Arseniure double de Cobalt et de Fer.* Bdt. Mixed with $Fe+4As$, &c. Mohs.
Bdt 469	Bright White Cobalt, P. 278. *Arseniure de Cobalt.* Bdt. *Speiskobalt.*
Bdt 431	Grey Cobalt, P. 279. *Sulfo-arseniure de Cobalt ou Cobaltagris.* Bdt. *Kobaltglanz.* Berz.
M. III. 88	Sulphuret of Cobalt, P. 280. *Schwefel-Kobalt.* Berz. Z. 196. *Cobaltkies?*
Bdt 470	Copper Nickel. Arsenical Nickel, P. 283. *Arseniure de Nickel.*
Bdt 430	Native Nickel, P. 282. *Sulfure de Nickel. Haarkies.*
Berz. Z. 196	*Nickel-Spiesglanzerz.* (Berz. gives $Ni+As$, $As+Sb$, $Sb+3s$) Breith. 248.
Bdt 435	Tin Pyrites. Sulphuret of Tin, P. 254. *Sulfure de Cuivre et Etain.* Bdt.
Bdt 401	Yellow Tellurium, P. 328. *Tellursilber.* $(2(Pb+2Te)+3(Au+3Te)+Ag+2Te)$. Berz, Z. 194. Mohs conjectures this to be a *Glance.*

ORDER XI. GLANCE.

THE *Order* GLANCE is remarkably well characterised. Its species consist of metallic bodies of a blackish or grey colour, almost in all cases resembling lead, and thus differing much from the preceding order Pyrites, in which the minerals resemble brass or tin. The two orders also differ in their hardness, the members of this being generally very soft, (mostly below 3.0) while the former orders were very hard, (generally above 5.0). They are also distinguished by their lustre, colour, metallic streak, and various other properties from the succeeding order *Blende*.

As has already been noticed, the chemical composition of this order resembles that of the preceding, the species consisting of metals combined with sulphur, and with substances, which in this respect are, it would seem, to be classed with sulphur. In the former order *Arsenic* appeared to be the principal other *Pyrites-making* ingredient. In this order, we find *Tellurium* taking the office of sulphur as a *Glance-making* substance; (in Black Tellurium Glance, Graphic T. G. and Yellow T. G.) It appears also that *Selenium* may have a similar function, as in Seleniferous Silver Glance; and it is said that Lead Glance is found with the whole or a part of its sulphur replaced by Selenium.

Though the *name* GLANCE has not been employed by Mr. Phillips, it is in various cases, as in Lead Glance, so familiar to English mineralogists that its adoption will not appear strange. In the remaining part of each name I have approached as nearly as possible to the usual designation of the mineral.

ORDER XI. GLANCE.

		H	G	
M.III.171	Yellow Tellurium (Glance?)	soft	10.7	Au, Ag, Pb, Te
21	Graphic Tellurium Glance	1.5..2.0	5.7..5.8	$3(Au+6Te)+Ag+2Te$
16	Black Tellurium Glance	1.0..1.5	7.0..7.1	$Pb+2Te\ (+Au, Ag, s)$
13	Lead Glance	2.5	7.4..7.6	$Pb+2s$ $Pb+2Se$
88	Arsenical Lead Glance	soft	8.444	$Pb+As$
19	Bismuth Glance	2.0..2.5	6.1..6.4	$Bi+2s$
128	Specular Bismuth Glance	soft	8.0	$Bi, Te\ (+Se)$
91	Cupriferous Bismuth Glance	soft		Bi, Cu, s
130	Acicular Bismuth Glance	2.0..2.5	6.1.25	Bi, Pb, Cu, s
78	Argentiferous Bismuth Gl.	soft		$Bi, Pb, Ag, s\ (+Fe)$
18	Molybdenum Glance	1.0..1.5	4.4..4.6	$Mo+2s$
23	Grey Antimony Glance	2.0	4.2..4.7	$Sb+3s$
26	Axotomous Antimony Glance	2.0..2.5	5.5..5.8	Sb, Pb, s
8	Vitreous Silver Glance	2.0..2.5	6.9..7.2	$Ag, 2s$
94	Seleniferous Silver Glance	soft		$2(C+Se)+Ag+2s$
73	Cupriferous Silver Glance	soft	6.255	$2(Cu+s)+Ag+2s$
27	Brittle Silver Glance	2.0..2.5	5.5..5.8	Ag, As, s

Bdt 461	Yellow Tellurium, P. 328. $Au+3Te$, $Ag+2Te$, $Pb+2Te$. See the last order.
Bdt 462	Graphic Tellurium. Graphic Gold, P. 327. *Schrifterz.* Germ.
Bdt 461	Black Tellurium, P. 328. *Nagyagerz.* Germ.
Bdt 428	Galena. Sulphuret of Lead, P. 332. Blue Lead, P. 325.
Leon. 591	Perhaps the same mineralogical species.
Mohs	*Cobaltic Galena or Cobaltic Lead Glance?* Jam. Rose also gives a formula $6(Pb+2Se)+(Co+4Se)$. Leon. 591.
Bdt 428	*Wismuthglanz.* Sulphuret of Bismuth, P. 273.
Leon. 589	*Molybdän Silver.* Molybdic Silver, P. 287. *Spiegelwismuthglanz.* Breith. 126. *Tellurure de Bismuth.* Bdt.
Mohs	Cupriferous Sulphuret of Bismuth, P. 274.
Bdt 196	*Needle Ore.* Plumbo-Cupriferous Sulphuret of Bismuth, P. 274. $2(Bi+2s)+(Cu+s)+Pb+2s$. Berz. Z. 196.
Mohs	Bismuthic Silver, P. 294.
Bdt 427	*Wasserblei.* Sulphuret of Molybdena, P. 248.
Bdt 428	Grey Antimony. Sulphuret of Antimony, P, 329.
	Stahlantimonglanz. Breith. 127. *Jamesonite.*
Bdt 423	Vitreous Silver. Sulphuret of Silver, P. 288.
Bdt 460	*Eucairite.* Seleniuret of Silver and Copper, P. 294.
Bdt 434	*Argentiferous Copper Glance.* Sulphuret of Silver and Copper, P. 293.
Bdt 432	*Spödglaserz.* Brittle Sulphuret of Silver, P. 290.

ORDER XI. GLANCE.

		H	G	
M. III. 30	ANTIMONIAL SILVER GLANCE	soft	5.5	Ag, Sb, s
30	FLEXIBLE SILVER GLANCE	soft		Ag, s, Fe
1	GREY COPPER GLANCE	2.5..4.0	4.4..5.8	$Cu, Fe, s,$
5	TRIPLE COPPER GLANCE	2.5..3.0	5.7..5.8	$Cu+s+(Pb+2s)+(Sb+3s)$
8	VITREOUS COPPER GLANCE	2.5..3.0	5.5..5.8	$Cu+s$
161	TENNANT COPPER GLANCE?	4.0	4.4	$\left.\begin{matrix}9(Cu+s)+\\Fe+As\end{matrix}\right\}?$
4	PRISMATOIDAL COPPER GLANCE?	3.0	5.7..5.8	Cu, Pb, Sb, s

Mohs	Sulphuret of Silver and Antimony, P. 290.
	Flexible Sulphuret of Silver, P. 289.
	Grey Copper. Fahlerz, P. 300.
	Arsenical Grey Copper, P. 301.
	Schwarzerz. Antimonial Grey Copper, P. 301.
Bdt 433	*Bournonite.* Triple Sulphuret of Copper, P. 336.
Bdt 426	Vitreous Copper. Sulphuret of Copper, P. 297.
Bdt 437	Tennantite, P. 304. *Cuivre gris Arsenifere,* Bdt. 436. Breith. makes this a Blende.
Mohs	

Order XII. BLENDE.

Though the Order *Blende*, like the two preceding ones, consists of minerals composed of a metal combined with sulphur, the difference in the appearance of the orders is very marked. Those belonging to the present order are remarkable for having an exterior unmetallic or imperfectly metallic; being often transparent, and possessing in almost all cases an adamantine lustre and decided colours, as red, purple, brown, &c. The streak

		H	*G*	
M.III.161	Copper Blende?	4.0	4.4	
81	Manganese Blende	3.5..4.0	3.9..4.1	$Mn + 2s$
32	Zinc Blende	3.5..4.0	4.0..4.2	$Zi + 2s$
36	Antimony Blende	1.0..1.5	4.5..4.6	$2(Sb+3s+\overset{\cdots}{Sb})$
38	Red Silver Blende	2.5	5.4..5.9	$3(Ag+2s)+$ $2(Sb+3s)$
42	Hemiprismatic Silver Blende	2.0..2.5	5.2..5.4	Ag, Sb, s
44	Quicksilver Blende	2.0..2.5	6.7..8.2	$Hg + 2s$
	Bismuth Blende	4.5..5.0	5.9..6.0	
49	Realgar?			

is generally coloured and somewhat different from the external colour. The specific gravity and hardness do not much differ from those of the last order.

The NAME *Blende* has been adopted in the case of *Zinc Blende,* which may be considered as the type of this order, and may easily be applied in the other cases.

	Tennantite, P. 304. *Kupfer Blende.* Breith. 131.
Bdt 430	*Schwarzerz.* Sulphuret of Manganese, P. 246.
Bdt 424	Blende. Sulphuret of Zinc, P. 351.
Bdt 438	Red Antimony, P. 331.
Bdt 433	Red Silver. Ruby Silver. P. 291.
Mohs	*Hemiprismatic Ruby Blende.* Dark Red Silver.
Bdt 427	Cinnabar. Sulphuret of Mercury, P. 358.
	Bismuthic Blende. Breith. in Brewster's Journ. *Oct.* 1827, p. 342.
	Realgar. Sulphuret of Arsenic, P. 276. Breith. p. 135.

ORDER XIII. SULPHUR.

OF the ORDER of Mohs, *Sulphur*, the resemblance is considerable to the Blendes, and one species, Realgar, has been by Breithaupt referred to that order. From the small number of species which have been collected under this order, it is difficult to know whether they are clearly connected in nature. Future investigation may determine thus.

		H	G	
M.III.49	REALGAR	1.5..2.0	3.5..3.6	$As + 2s$
47	ORPIMENT	1.5..2.0	3.4..3.6	$As + 3s$
52	SULPHUR	1.5..2.5	1.9..2.1	s

M.II.191	Plumbago	1.0..2.0	1.8..2.0	c, Fe

M. 56	Mellite	2.0..2.5	1.4..1.6	$\overset{\cdot\cdot\cdot}{A}, \quad \overset{\cdot\cdot}{mel}, \quad q$

For similar reasons it is not attempted here to enumerate the species of the remaining Orders of Mohs, *Resin* and *Coal.* The members of them which it seems most requisite to notice are added to this order.

	Realgar. Sulphuret of Arsenic, P. 276. It is made a Blende by Breith.
Bdt 329	Orpiment, P. 277. *Yellow Sulphuret of Arsenic.*
Bdt 422	Sulphur, P. 360.

Bdt 404	Plumbago. Graphite. Black Lead, P. 364. A *Bloom* in Mohs.

Bdt 403	Mellite, P. 374. *Mellate d' Alumine.*
M.III.110	Humboldtine, P. 242. *Oxalate de Fer.* Bdt. 403.
	Guano. Urate de Chaux. Bdt. 403

M.III.57	Amber, P. 373. Bitumen. Mineral Oil. Mineral Pitch, P. 366, 368. Bdt 400, 402.
146	Retinasphalt, P. 375. Bdt 401.
106	Hatchetine, P. 374. Bdt 401.
61	Coal. Jet. P. 370, 371, 372. Bdt 379, 398.
65	Anthracite, P. 374, 375. Bdt 397.